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## A GLANCE AT THE JURY SYSTEM.

By C. H. STEPHENS.

"Our little systems have their day;
They have their day, and cease to be."

THERE is no one, I fancy, who is in the habit of reading the newspapers, or of witnessing the conduct of jury-trials, but has often had occasion to laugh at the vagaries of juries and their curious verdicts. A volume might be filled with them which would rival in interest Dean Ramsay's "Reminiscences" or Joe Miller's "jokes." "It seems a daring and presumptuous thing," says a learned writer, "to attack as useless an institution on which writers, both lay and legal, have bestowed so much eulogy." And not only does it seem daring and presumptuous, but one can hardly in imagination conceive a time when the jury, with all its record of past services, all its glorious battles for liberty, and all its memories of great pleaders, shall have passed away; when the jury-box, with its "twelve men all arow," shall have disappeared; and when the challenge to the array, and the challenge to the poll, the pathetic addresses of counsel, and the judge's charge, shall be heard of no more forever. Nevertheless, when we see, every month or two, fifty, sixty, or seventy men drafted from the industrial classes to supply what is called a 'petty jury," and a couple of dozen more from, perhaps, a somewhat higher class, to form what is called a "grand jury"; when we see the farmer leave his plow, the builder his building, and the shopkeeper his counter, and come together from places many miles apart; when we see them day after day idling about the courts and taverns; when we see them in the jury-box listening lazily to the proceedings before them; when we hear them delivering

verdicts to which the judgments of Sancho Panza were, in comparison, as the judgments of Solomon; and when we learn that for all this the country pays their traveling expenses, their hotel bills, and so much *per diem* for their services—we can not but believe that the day is not far distant when the jury system, with all its glories and eccentricities, will be a thing of the past. It is rude, clumsy, and out of harmony with the progress of the world. It smacks of a former age and a cruder civilization. It reminds one of the clod of earth, and the lictor's rod; the trial by ordeal, and benefit of clergy. It belongs to these, and not to the age in which we live. With these it arose, and to these it will in time be gathered. The question is, Has not that time arrived now? Is not the world capable of a more perfect system to-day; and if so, what?

No system that can be suggested as superior to the jury can be positively shown in advance to be so. There are so many factors of uncertain quantity which enter into the calculation, that nothing like a perfect estimate of the respective merits of any two systems is possible. By what rule of mathematics can we arrive at the respective wisdom and sagacity of a jury of twelve men as compared with a bench of one, two, or three judges, or their respective honesty, impartiality, and so on? But more, perhaps, in the way of exact calculation is possible than has yet been accomplished. Something is possible, at least, by way of an exact estimate of the relative expense of any two systems. That is one item. Then, something may be done, though perhaps not much, by way of a comparison of the results of a certain term or terms of court in a certain district, where the jury system prevails, with those of a corresponding term or terms in a district where a judge alone decides the questions at issue. In the item of expense must be reckoned the loss to the country by reason of so many persons being taken from their natural employments, the temptations into which they are thrown, and the demoralizing influences to which they are subject. But these calculations pertain more to a commission of inquiry, and I do not propose to enter into them. Neither do I propose to enter, even theoretically, into the great question whether society would not be the gainer in point of morality by an administration of the criminal laws in which a jury would have no part, but merely, by way of introduction to these questions, take a brief glance at what the jury system really is.

It will be admitted, I think, that the jury of real life does not correspond to its ideal. There seems to be a vague, indefinable something about it, which is ever whispering in the ear of Civilization, "Hold fast by me, or you are lost!" But examine the phantom, and it disappears. Whatever of reality it may once have had, has passed away. The language of the old encomiasts would now seem foolish and extravagant. "The jury system," says one writer, "considered as a means of deciding contestations between individuals and of ascertain-

ing the guilt or innocence of accused persons is, in England, the basis of public liberty, the bulwark of the people against oppression, the legal guarantee of life, of honor, and of the property of the citizens. A jury is the buckler of innocence against unjust accusations, and the sworn arbiter of those who have recourse to the tribunals in order to obtain justice. Under this institution the laws may be the means of protection or of destruction, of hope or of misery, according to the spirit, the firmness, and the integrity of the jurors." This is the language of a writer at the beginning of the present century. They are his opening words—the overture, so to speak, of his work. But the qualification he has seen fit to append to it seems, logically, to bring the wordy structure to the ground.

How the jury can be "the basis of public liberty, the bulwark of the oppressed, the buckler of innocence," and so on, and yet depend for all these upon the character of the men who compose it, one can hardly imagine. If the jurymen were all wise, honest, and true—if, in short, they were perfect—we would, undoubtedly, have perfect verdicts. But, if all judges were perfect, the same result would be arrived at in a much simpler way. We can only look for perfect judges and perfect juries when all mankind are perfect; and, when all mankind are perfect, there will be no need of either. And though the jury may have been once all that is thus ascribed to it, how can it be so now? In what manner can it be said to be the basis of public liberty at the present day, and who are the oppressed?

The ideal juryman is not supposed to be more perfect than the ordinary run of mankind; but he is supposed to enter the jury-box free from all prejudices or predilections concerning the matter to be decided. He is supposed to be chosen according to a system which insures the highest degree of impartiality—a system which, in large communities at least, makes the selection of each juror a matter of pure chance. But in such communities there is a large amount of business to be disposed of, and a large number of persons, called a panel, is required, from which each particular jury is taken. This furnishes a considerable quantity of material—of raw material, it may be called—from which the actual twelve are to be selected. These persons are drawn from a class of society the most plastic, the most subject to prejudices and animosities; and it is a well-recognized part of the business of counsel to secure from among them those who may have leanings toward their clients.

Their success or otherwise in this particular is, in all cases of importance, made the subject of the closest calculation. And a counsel is not considered to have shown any marked aptitude if he has not upon the jury one or more upon whose sympathies he can count. The many interests of a national, religious, or friendly character which pervade all society aid in this.

The sympathies of coreligion, copatriotism or confraternity are all

instruments with which the skillful counsel either openly or secretly works.*

The ideal jury is unanimous. The unanimity of the real jury is, in the great majority of cases of any importance, a mere name. That they are required to be unanimous has been admitted from time immemorial to be a defect in the system. The absurdity of *compelling* men to be unanimous must be apparent to the crudest intellects. In olden times in England when the judges "went circuit" they used to carry the jury around with them in carts until they agreed. In our time we have not much advanced beyond this. We lock them up, with barely the necessaries of life, until they are unanimous. The value of a verdict obtained under such conditions is not very evident. In an old case eight of the jury agreed to find "not guilty" and the other four "would find it murder." The next morning two of the four agreed with the eight. At last the rest came to this agreement, viz., that they would offer "not guilty," and if the court disliked it, then they would change the verdict, and find it "guilty"!

The foreman pronounced "not guilty," but the court, "not liking it," examined every one of them by the poll, whether that was their verdict, and ten of them affirmed it, but the last two discovered the whole matter; *whereupon they went back and then brought in "guilty."* The ten were all fined in considerable amounts for their conduct. It is not wonderful that, recognizing, as they must do, the ineffectual nature of their proceedings, jurymen have resorted to the very simple and suggestive expedient of casting lots for their verdict. Several instances are recorded in the books of juries casting lots for it, and in a recent murder trial in England it was discovered that the jury had balloted for their decision. To a candid and independent observer the whole effect of a jury-trial must appear about equivalent to drawing lots. Its value as a means of discovering truth can be little if any beyond this. Any one who will reflect on the matter for a moment will, I think, be convinced that the proportion of correct verdicts can not be much, if any, more than fifty in a hundred, which is, of course, the average in every question of pure chance. Almost every jury-trial is as though the parties acting in it went through a mock solemnity of greater or less duration according to the importance of the case, at the conclusion of which the judge said to the jury: "We have exhibited to you the spectacle of a trial; you will retire now, and cast dice as to what your verdict will be." And if this be true, a system which would dispense with the jury, and in which the court itself would throw the dice, should be quite as satisfactory. It is certain that under such a system the very highest degree of impartiality would be reached, while there would be a vast saving in time and expense.

* The Cincinnati riot, which occurred some time after this was written, would appear to lend additional force to this observation, as it was undoubtedly to one of these causes that the extraordinary verdict which led to the riot was due.

This is in cases where the decision is actually left in the hands of the jury. But, and this is another difference between the real and the ideal in the jury system, we have in a large number of cases the more extraordinary spectacle of a jury solemnly sitting through a trial for the purpose of listening to the evidence and forming their own opinion as to the guilt or innocence of the accused, and then being instructed by the court as to the verdict they shall find. It is, as every one knows, the most common of occurrences for the judge to lecture the jury upon their verdict and to refuse to receive it. That the judge should be more correct than the jury is not impossible, but then—wherefore the jury? In an English case in which the jury had brought in "guilty," Mr. Justice Maule addressed the prisoner as follows: "Prisoner at the bar, your counsel thinks you innocent; the counsel for the prosecution thinks you innocent; I think you innocent. But a jury of your own countrymen, in the exercise of such common sense as they possess, and it does not seem to be much, have found you guilty, and it remains that I should pass upon you the sentence of the law. That sentence is that you be kept in imprisonment for one day, and, as that day was yesterday, you may now go about your business." In a case the other day in San Francisco the judge made similar comments, though to the jury themselves.* The real value of these two anecdotes is ordinarily overlooked. It is something beyond merely raising a laugh at the expense of the jury. The laugh is not necessarily at the expense of the jury at all. It is rather at a system which takes up the time of twelve men in hearing a case and rendering a verdict, and then takes it for granted that the one man who sits on the bench knows more about it than the whole twelve. If the "unanimous" verdict of the twelve is not equal in wisdom to that of the judge who lectures them, it is clear that they may be dispensed with, without any great loss to society.

And, if unlike its ideal, still less is the jury of to-day like its original. A glance at the history of the jury system will show this. The original notion of a jury was not as a protection to anybody. It was not established as a bulwark of popular liberty. The jurymen were witnesses rather than judges of the matter in issue. The modern jury grew by a process of slow and gradual development out of customs which were part of the life of the Anglo-Saxons and other early inhabitants of Great Britain. These customs were perfectly characteristic of a rude, unlettered people. They were perfectly natural. They were based on no recognized legal principle. They had no set purpose in view beyond the purpose of the hour. They were almost utterly devoid of judicial forms. There was no such thing known as a writ. For the hearing of a complaint a messenger was sent personally to

* A notable instance of a judge's overruling the decision of a jury has just occurred in England. In the suit of Adams against Coleridge a verdict was rendered for the plaintiff, and was immediately reversed by the presiding judge.—[EDITOR.

summon the people of the *hundred* in which the dispute arose or the crime was committed. They were to be of the vicinage or neighborhood of the parties. It was necessary that they should know something of the matters in dispute, or the persons accused. They were to decide of their own knowledge. Witnesses in the modern sense were unknown. The parties stated their grievance in the presence of this rude assemblage, which, by a species of acclamation, or preponderance of lung-power, which often terminated in an appeal to brute force, determined the question in issue.

Among the northern tribes something more nearly approaching to a court and jury is said to have existed, but among the Anglo-Saxons judicial forms were of the rudest possible description. By a law of Ethelred twelve men with the sheriff were to go out and discover all who had committed offenses and accuse them. Later grew the practice, introduced by the clergy from the canon law, of swearing the witnesses (as the jury were termed), and of requiring sworn evidence in all cases, both civil and criminal. And by the laws of Edgar it was provided that in every hundred there should be twelve sworn men to be appointed as witnesses, some of whom were to witness every transaction, that they might be afterward called to decide concerning it. The refinements of the ecclesiastical law, and the clergy, who only could read and write, did much to soften the asperities and barbarities of the customs which were in process of time molded into the common law of the country.

The modern jury is no more than the tumultuous assembly of the Anglo-Saxons molded into judicial form by the introduction of sworn evidence, by the separation of the grand and petty juries, and by the establishment of the number twelve—a number common for many purposes among the northern tribes of Europe. In its early stages it had no reference to a dread of monarchical aggression. Witness the fact that Alfred caused forty-four justices to be hanged in one year for delivering false judgments and sentences contrary to the verdict of the jury. From this time the jurisprudence of England rapidly improved. Under the Normans, who succeeded, the jury system showed marked signs of development. In the reign of William II occurred the first instance of twelve men sworn to render a verdict in anything like the modern sense. That was in a cause between the Bishop of Rochester and the sheriff. The jurors, awed by the influence of the sheriff, decided in his favor, which the bishop suspecting, he commanded them to choose twelve men who should confirm it on oath. In this we see the first rudiments of the petty jury.

Another cause which led to the differentiation of the petty jury from the general body of jurors (or witnesses) was what is known in English law as the presentment of Englishry. By a law of the Norman kings, the people of the hundred in which a murder was committed were bound to discover the murderer or pay a fine, unless they proved

that the person murdered was English. As this last was a task usually attended with great difficulty, it became the practice of the people of the hundred to discover the criminal, and, when found, to accuse him of the crime; but as these accusers, when they had apprehended the accused, were found liable to be prejudiced against him, the custom grew of choosing twelve, who might be taken, not only from the hundred, but from the whole body of the county, whose functions were to decide as to the guilt or innocence of the accused. Under the first Henry the jurors, though still witnesses, and deciding exclusively from their own knowledge, began to be called judges—a fact which seems to indicate that the office of deciding began to be recognized as the principal part of their duty. In the following reign, Henry II recognized the value of the jury system as a check upon the power and rapacity of the barons; and, consequently, in the tenth year of his reign, was enacted the first legislation on record establishing the right of trial by jury. In the constitutions of Clarendon, passed in that year, it was provided that laymen should not be accused unless by certain legal accusers, the witnesses, *and that if the offenders were such whom no one wished or desired to accuse*, that then twelve men should be sworn "who should declare the truth according to their conscience."

It is noted as a curious fact that the jury system, whose great value has always been as a means of checking the encroachments of the crown upon popular liberty, should thus have been first officially introduced to the world as a means of strengthening the crown in its endeavors to check the encroachments of others. And it may be noted as an equally curious fact that the importance of the jury, as thus first established, was in gaining convictions rather than in evading them. Jurors, however, were still witnesses—"deciding by what they had seen and heard." Indeed, it was not until the reign of Henry VI (fifteenth century) that jurors were of sufficient intelligence to listen to and decide upon extraneous evidence; and not until the reign of Anne (eighteenth century) that it was enacted that the want of "hundredors" should not be a cause of challenge to the jury.

From this brief recital it will be seen that the last stage in the development of the modern jury was reached when, in the fifteenth century, the jurors began to listen to the evidence of others, and ceased to rely upon their own. The importance of the jury prior to this period has been very much overstated. The reference to it in Magna Charta does not warrant all the eloquence that has been expended upon it. The events which gave rise to Magna Charta and the condition of the people of England at that time preclude the idea that the jury system owes its existence, or at any rate its place in Magna Charta, to the "freedom-loving instincts of the Anglo-Saxons." A proper conception of the jury itself, as it then existed, equally precludes the idea that it possessed the importance, even in the eyes of those who obtained the charter, which people in later times have been

wont to attach to it. Among the phenomena of human life is this, that in all countries and ages certain ideas or beliefs have been found so pleasing to the national vanity as to be regarded as the most fundamental of truths. They have descended from generation to generation as a sort of popular inheritance. They have formed part of the education of youth and the entertainment of maturer age. They have been placed, so to speak, in the national Pantheon, and worshiped as at least half divine.

No one ever thought of doubting them, because to do so would be sacrilege; to deny them, a crime. Instances of this will occur to every one, and no more marked instance can be found than this, that we owe trial by jury to the wisdom, courage, and foresight of the Anglo-Saxons of the reign of John. A reference to the circumstances of that period will make this evident.

In consequence of their miserable condition, the hardships and exactions of the feudal system, and the cruelty and rapacity of those above them, the Anglo-Saxons, who constituted the lowest orders of the people at that time, were crying out for a return to the laws and customs of the Anglo-Saxon period. These customs included, as we have seen, a sort of trial by jury of the crudest and most rudimentary kind. But it was not for this they cried. This, such as it was, they had never lost. Under the Norman kings it was encouraged rather than suppressed, and in the reign of John had advanced far toward a regular judicial system. To this extent only can the reference to trial by jury in Magna Charta be ascribed to the Anglo-Saxons—viz., that it was one of the customs of the English people descended from the Anglo-Saxon period, confirmed by many subsequent charters, and enrolled in the great charter as part of the national constitution. To understand this it is indispensable to remember what the great charter was, and how little in reality the lower orders had to do with it. The struggle out of which it arose was not with them at all. It was a contest between the king and the barons, who set at naught his authority, who hanged his officers, and who rebelled against his outrages and abuses. It was they, the greatest enemies of the Anglo-Saxons, whose interest was in framing the laws so that they might ravage the common people with impunity, and at the same time escape similar treatment on the part of the king, who compelled the latter to sign Magna Charta. And so clearly were their interests opposed to the system of trial by jury, that it has been confidently asserted that the famous jury clause was due to the king himself. It seems more reasonable, however, to ascribe it to the archbishop and the clergy, by whom the document was undoubtedly drawn, and to whom its peculiar phraseology is undoubtedly due. But what is more credible, and, if true, more important, is the assertion on high authority that the words *judicium parium*, or judgment of peers, which are supposed to embody the great central principle of trial by jury, do not refer to

criminal matters at all—the decision in which was never termed *judicium*, but *veridictum*. So that the most that can with safety be asserted of these two famous words is this, that out of them was evolved the great principle which in after-years was to stand in the breach in many a bitter struggle between law and force, and to play so important a part in the history of civilization.

And indeed that is the light in which the whole of this great act is to be regarded. It is all of a piece with the *judicium parium* and *habeas corpus* clause, the assertion of the supremacy of law in all ranks and orders of society. Laws had existed before the time of John, but they were but additional instruments in the hands of the strong to oppress the weak. Under the Saxon kings the laws were neither understood nor regarded. Every man was a law unto himself, and the result was anarchy and barbarism.

Under the Norman kings law was recognized and partially understood, but it was enforced only against those least powerful to violate it. Each Norman king in turn granted and confirmed the laws to the people, but himself outraged every law, both human and divine. The feudal lords right nobly imitated their example; and, so great grew their exactions that, like the Hebrews of old, the people cried aloud for a deliverer. The deliverer came in the person of a king more sensual, more vile, and more tyrannical than any who had preceded him; a king who ground the faces of the rich as well as of the poor; who outraged the noble as well as the base-born; who oppressed the strong as well as the weak. And the rich and the noble and the strong stood up; the barons turned against the king, and the king against the barons, and out of the contest arose the supremacy of the law. Law became the sole arbiter of right and wrong among all classes, and force and violence and the savage instincts of man became subject thereto.

For upward of five centuries the principles of Magna Charta have governed the Anglo-Saxon world, and among them the principle of trial by jury has held its place. The tyranny of absolute monarchy is gone, and the brutality of the barons has long since passed away, but the jury system remains. Since the days of William III, when the supremacy of the law was finally vindicated, and the judges were made independent of the crown, trial by jury has been little more than a form; yet English-speaking people everywhere cling to it as a lately bereaved wife clings to the form of him who through many long years has been her shield and protector.

In this age all men are peers and equals in the eyes of the law, yet a jury of twelve, with all its ancient crudities, and all its modern anomalies, is still considered essential to a fair and impartial trial.

Time was when the jury were judges of the law as well as the fact. To-day they are in fact judges of neither. They are but the echo of the court, and their principal office is to relieve the court of the respon-

sibility of what is done. When a judge sentences a prisoner, he says, in effect: "Do not blame me, I pray you. You have been condemned by the 'unanimous' verdict of twelve of your fellows. I am but the mouth-piece of the law to pass sentence according to their verdict." Of course this is not so. In a great proportion of cases the very reverse is the case. The jury are, in fact, but the mouth-piece of the judge to render a verdict, the responsibility of which he wishes to be relieved of.

Let us ask ourselves if there really is anything to be gained by the continuance of a system so full of incongruities. People are commencing to ask this question now. One authority says, "Apart from any incidental defects, it may be doubted whether, as an instrument for the investigation of truth, the jury deserves all the encomiums that have been passed upon it." But the same writer goes on to point out that, while the jury might with advantage be dispensed with in civil cases, "opinion in England is unanimously against subjecting a man to serious punishment without the verdict of a jury, and the judges themselves," he adds, "would be the first to deprecate so great a responsibility." But that public sentiment is in favor of the jury system does not prove it to be the best, even in criminal cases. Mere sentiment is not an argument for the continuance of any system, and moral cowardice is not even an apology for one. Every system, every institution, however useful in the past, whatever may be its claims on the reverence or affection of mankind, must, sooner or later, be brought to the test of present and practical worth. In the Bank of England one is shown a very delicate and ingenious instrument for weighing coins. The coins pass up a tube, at the top of which they pause for a moment and are weighed. If good, they drop into a receiver on the one hand; if bad, they infallibly go to the other. No human agency is visible, yet each in its turn which does not come up to the standard of this remorseless little instrument is cast aside and rejected. All the institutions of the past are coins for which the age has invented weighing-machines. Each must come up to the standard of actual value, of undoubted utility, or be cast aside. The jury system will be no exception to these. In several countries it is now only used in civil matters. Throughout the Austrian Empire it has been abolished entirely. Law everywhere is undergoing a process of simplification. In English-speaking countries in particular it has, during the last few years, been purged of many abuses, stripped of much that was useless, and, in a few years more, trial by jury will also be swept away.

# AGNOSTIC METAPHYSICS.

By FREDERIC HARRISON.

TEN years ago I warned Mr. Herbert Spencer that his Religion of the Unknowable was certain to lead him into strange company. "To invoke the Unknowable," I said, "is to reopen the whole range of Metaphysics; and the entire apparatus of Theology will follow through the breach." I quoted Mr. G. Lewes's admirable remark,* "that the foundations of a Creed can rest only on the Known and the Knowable." We see the result. Mr. Spencer has developed his Unknowable into an "Infinite and Eternal Energy, by which all things are created and sustained." He has discovered it to be the Ultimate Cause, the All-Being, the Creative Power, and all the other "alternative impossibilities of thought" which he once cast in the teeth of the older theologies. Naturally there is joy over one philosopher that repenteth. The "Christian World" claims this as equivalent to the assertion that God is the mind and spirit of the universe; and the "Christian World" says these words might have been used by Butler or Paley.† This is, indeed, true; but it is strange to find the philosophy of one who makes it a point of conscience not to enter a church described as "the fitting and natural introduction to inspiration!"

The admirers of Mr. Spencer's genius—and I count myself among the earliest—will not regret that he has been induced to lay aside his vast task of philosophic synthesis, in order more fully to explain his views about Religion. This is, indeed, for the thoughtful, as well as the practical, world, the great question of our age, and the discussion that was started by his paper‡ and by mine* has opened many topics of general interest. Mr. Spencer has been led to give to some of his views a certainly new development, and he has treated of matters which he had not previously touched. Various critics have joined the debate. Sir James Stephen‖ has brought into play his Nasmyth hammer of Common Sense, and has asked the bold and truly characteristic question: "Can we not do just as well without any religion at all?" The weekly Reviews, I am told, have been poking at us their somewhat hebdomadal fun. And then Mr. Wilfrid Ward,^ "the rising hope of the stern and unbending" Papists, steps in to remind us of the ancient maxim—*extra Ecclesiam nulla salus.*

I can not altogether agree with a friend who tells me that contro-

* "Problems of Life and Mind," vol. i. Preface.

† "The Christian World," June 5 and July 3, 1884.

‡ H. Spencer, in "Nineteenth Century," January and July, 1884.

* F. Harrison, in "Nineteenth Century," March, 1884.

‖ Sir J. Stephen, in "Nineteenth Century," June, 1884.

^ W. Ward, in "National Review," June, 1884.

versy is pure evil. It is not so when it leads to a closer sifting of important doctrines; when it is inspired with friendly feeling, and has no other object than to arrive at the truth. There were no mere "compliments" in my expressions of respect for Mr. Spencer and his work. I habitually speak of him as the only living Englishman who can fairly lay claim to the name of philosopher; nay, he is, I believe, the only man in Europe now living who has constructed a real system of philosophy. Very much in that philosophy I willingly adopt; as a philosophical theory I accept his idea of the Unknowable. My rejection of it as the basis of Religion is no new thing. The substance of my essay on the "Ghost of Religion" I have long ago taught at Newton Hall. The difference between Mr. Spencer and myself as to what religion means is vital and profound. So deep is it that it justifies me in returning to these questions, and still further disturbing his philosophic labor. But our long friendship, I trust, will survive the inevitable dispute.

It will clear up much at issue between us if it be remembered that to me this question is one primarily of religion; to Mr. Spencer, one primarily of philosophy. He is dealing with transcendental conceptions, intelligible only to certain trained metaphysicians: I have been dealing with religion as it affects the lives of men and women in the world. Hence, if I admit with him that philosophy points to an unknowable and inconceivable Reality behind phenomena, I insist that, to ordinary men and women, an unknowable and inconceivable Reality is practically an Unreality. The Everlasting Yes which the Evolutionist metaphysician is conscious of, but can not conceive, is in effect on the public a mere Everlasting No; and a religion which begins and ends with the mystery of the Unknowable is not religion at all, but a mere logician's formula. This is how it comes about that Mr. Spencer complains that I have misunderstood him or have not read his books, that I fail to represent him, or even misrepresent him. I can not admit that I have either misunderstood him or misrepresented him on any single point. I have studied his books part by part and chapter by chapter, and have examined the authorities on which he relies.

He seems to think that all hesitation to accept his views will disappear if men will only turn to his "First Principles," his "Principles of Sociology," and his "Descriptive Sociology," where he has "proved" this and "disproved" that, and arrayed the arguments and the evidence for every doctrine in turn. Now, for my part, I have studied all this, to my great pleasure and profit, since the first number of "A Synthetic Philosophy" appeared. Mr. Spencer objects to discipleship, or I would say that I am in very many things one of his disciples myself. But in this matter of religion I hold still, as I have held from the first, that Mr. Spencer is mistaken as to the history, the nature, and the function of religion. It is quite true that he and I are at

opposite poles in what relates to the work of religion on man and on life. In all he has written, he treats religion as mainly a thing of the mind, and concerned essentially with mystery. I say—and here I am on my own ground—that religion is mainly a thing of feeling and of conduct, and is concerned essentially with duty. I agree that religion has also an intellectual base; but here I insist that this intellectual basis must rest on something that can be known and conceived and at least partly understood; and that it can not be found at all in what is unknowable, inconceivable, and in no way whatever to be understood.

Now, in maintaining this, I have with me almost the whole of the competent minds which have dealt with this question. Mr. Spencer puts it rather as if it were merely fanaticism on my part which prevents me from accepting his theory of Religion; as if Sir James Stephen's difficulties would disappear if he could be induced to read the "Principles of Sociology" and the rest. Mr. Spencer must remember that in his Religion of the Unknowable he stands almost alone. He is, in fact, insisting to mankind, in a matter where all men have some opinion, on one of the most gigantic paradoxes in the history of thought. I know myself of no single thinker in Europe who has come forward to support this religion of an Unknowable Cause, which can not be presented in terms of consciousness, to which the words emotion, will, intelligence can not be applied with any meaning, and yet which stands in the place of a supposed anthropomorphic Creator. Mr. George H. Lewes, who of all modern philosophers was the closest to Mr. Spencer, and of recent English philosophers the most nearly his equal, wrote ten years ago: "Deeply as we may feel the mystery of the universe and the limitations of our faculties, *the foundations of a creed can only rest on the Known and the Knowable.*" With that I I believe every school of thought but a few dreamy mystics has agreed. Every religious teacher, movement, or body, has equally started from that. For myself, I feel that I stand alongside of the religious spirits of every time and of every church in claiming for religion some intelligible object of reverence, and the field of feeling and of conduct, as well as that of awe. Every notice of my criticism of Mr. Spencer which has fallen under my eye adopted my view of the hollowness of the Unknowable as a basis of Religion. So say Agnostics, Materialists, Sceptics, Christians, Catholics, Theists, and Positivists. All with one consent disclaim making a Religion of the Unknowable. Mr. Herbert Spencer may construct an Athanasian Creed of the "Inscrutable Existence"—which is neither God nor being—but he stands as yet *Athanasius contra mundum.* It is not, therefore, through the hardness of my heart and the stiffness of my neck that I can not follow him here.

Let us now sum up the various positions which Mr. Spencer would impose on us as to Religion. After his two articles and the recent

discussion we can hardly mistake him, and they justify my saying that they form a gigantic paradox. Mr. Spencer maintains that:

1. The proper object of Religion is a Something which can never be known, or conceived, or understood; to which we can not apply the terms emotion, will, intelligence; of which we can not affirm or deny that it is either person, or being, or mind, or matter, or indeed anything else.

2. All that we can say of it is, that it is an Inscrutable Existence or an Unknowable Cause: we can neither know nor conceive what it is, nor how it came about, nor how it operates. It is, notwithstanding, the Ultimate Cause, the All-Being, the Creative Power.

3. The essential business of religion, so understood, is to keep alive the consciousness of a mystery that can not be fathomed.

4. We are not concerned with the question, "What effect this religion will have as a moral agent?" or, "Whether it will make good men and women?" Religion has to do with mystery, not with morals.

These are the paradoxes to which my fanaticism refuses to assent.

Now these were the views about Religion which I found in Mr. Spencer's first article, and they certainly are repeated in his second. He says: "The Power which transcends phenomena can not be brought within the forms of our finite thought" "The Ultimate Power is not representable in terms of human consciousness." "The attributes of personality can not be conceived by us as attributes of the Unknown Cause of things." "The nature of the Reality transcending appearances can not be known, yet its existence is necessarily implied." "No conception of this Reality can be framed by us." "This Inscrutable Existence which Science, in the last resort, is compelled to recognise as unreached by its deepest analyses of matter, motion, thought, and feeling." "In ascribing to the Unknowable Cause of things such human attributes as emotion, will, intelligence, we are using words which, when thus applied, have no corresponding ideas. There can be no kind of doubt about all this. I said Mr. Spencer proposes, as the object of religion, an abstraction which we can not conceive, or present in thought, or regard as having personality, or as capable of feeling, purpose, or thought—in familiar words, I said it was "a sort of a something, about which we can know nothing."

Mr. Spencer complains that I called this Something a negation, an All-Nothingness, an ($x^2$), and an Everlasting No. He now says that this Something is the All-Being. The Unknowable is the Ultimate Reality—the sole existence;—the entire Cosmos, as we are conscious of it, being a mere show. In familiar words:—"Everything is nought, and the Unknowable is the only real Thing." I quite agree that this is Mr. Spencer's position as a metaphysician. It is not at all new to me, for it is worked out in his "First Principles" most distinctly. Ten years ago, when I reviewed Mr. Lewes's "Problems of Life and

Mind," I criticised Mr. Spencer's Transfigured Realism as being too absolute.* I then stated my own philosophical position to be that, "our scientific conceptions within have a good working correspondence with an (assumed) reality without—we having no means of knowing whether the absolute correspondence between them be great or small, or whether there be any absolute correspondence at all." To that I adhere; and, whilst I accept the doctrine of an Unknown substratum, I can not assent to the doctrine that the Unknowable is the Absolute Reality. But I am quite aware that he holds it, nor have I ever said that he did not. On the contrary, I granted that it might be the first axiom of science or the universal postulate of philosophy. But it is not a religion.†

I said then, and I say still, speaking with regard to religion, and from the religious point of view, that the Metaphysician's Unknowable is tantamount to a Nothing. The philosopher may choose to say that there is an Ultimate Reality which we can not conceive, or know, or liken to anything we do know. But these subtleties of speculation are utterly unintelligible to the ordinary public. And to tell them that they are to worship this Unknowable is equivalent to telling them to worship nothing. I quite agree that Mr. Spencer, or any metaphysician, is entitled to assert that the Unknowable is the sole Reality. But religion is not a matter for Metaphysicians—but for men, women, and children. And to them the Unknowable is Nothing. Sir James Stephen calls the distinctions of Mr. Spencer "an unmeaning play of words." I do not say that they are unmeaning to the philosophers working on metaphysics. But to the public, seeking for a religion, the Reality or the Unreality of the Unknowable is certainly an unmeaning play of words.

Even supposing that Evolution ever could bring the people to comprehend the subtlety of the All-Being, of which all things we know are only shows, the Unknowable is still incapable of supplying the very elements of Religion. Mr. Spencer thinks otherwise. He says, that although we can not know, or conceive it, or apply to it any of the terms of life, or of consciousness, "it leaves unchanged certain of the sentiments comprehended under the name of religion." "Whatever components of the religious sentiment disappear, there must ever survive those which are appropriate to the consciousness of a Mystery!" Certain of the religious sentiments are left unchanged! The consciousness of a Mystery is to survive! Is that all? "We are not concerned," says he, "to know what effect this religious sentiment will have as a moral agent!" A religion without anything to be known, with nothing to teach, with no moral power, with some rags of religious

* "Fortnightly Review," 1874, p. 89.

† My words were that, "although the Unknowable is logically said to be Something, yet the something of which we neither know nor conceive anything is practically nothing." That is, speaking from the point of view of religion.

sentiment surviving, mainly the consciousness of Mystery; this is, indeed, the mockery of Religion.

Forced, as it seems, to clothe the nakedness of the Unknowable with some shreds of sentiment, Mr. Spencer has given it a positive character, which for every step that it advances towards Religion recedes from sound Philosophy. The Unknowable was at first spoken of as an "unthinkable abstraction," and so undoubtedly it is. But it finally emerges as the Ultimate Reality, the Ultimate Cause, the All-Being, the Absolute Power, the Unknown Cause, the Inscrutable Existence, the Infinite and Eternal Energy, from which all things proceed, the Creative Power, "the Infinite and Eternal Energy, by which all things are created and sustained." It is "to stand in substantially the same relation towards our general conception of things as does the Creative Power asserted by Theology.' "It stands towards the Universe, and towards ourselves, in the same relation as an anthropomorphic Creator was supposed to stand, bears a like relation with it, not only to human thought but to human feeling." In other words the Unknowable *is* the Creator; subject to this, that we can not assert or deny that he, she, or it, is Person, or Being, or can feel, think, or act, or do anything else that we can either know or imagine, or is such that we can ascribe to Him, Her, or It anything whatever within the realm of consciousness.

Now, the Unknowable, so qualified and explained, offends against all the canons of criticism, so admirably set forth in "First Principles," and especially those of Dean Mansel, therein quoted and adopted. The Unknowable is not unknowable if we know that "it creates and sustains all things." One need not repeat all the metaphysical objections arrayed by Mr. Spencer himself against connecting the ideas of the Absolute, the Infinite, First Cause, and Creator with that of any one Power. How can Absolute Power create? How can the Absolute be a Cause? The Absolute excludes the relative; and Creation and Cause both imply relation. How can the Infinite be a Cause, or create? For if there be effect distinct from cause, or if there be something uncreated, the Infinite would be thereby limited. What is the meaning of All-Being? Does it include, or not, its own manifestation? If the Cosmos is a mere show of an Unknown Cause, then the Unknown Cause is not Infinite, for it does not include the Cosmos; and not Absolute, for the Universe is its manifestation, and all things proceed from it. That is to say, the Absolute is in relation to the Universe, as Cause and Effect. Again, if the "very notions, beginning and end, cause and purpose, relative notions belonging to human thought, are probably irrelevant to the Ultimate Reality transcending human thought" (Spencer, "Nineteenth Century," p. 12), how can we speak of the Ultimate Cause, or indeed of Infinite and Eternal? The philosophical difficulties of imagining a First Cause, so admirably put by Mr. Spencer years ago, are not greater than those of imagining an

Ultimate Cause. The objections he states to the idea of Creation are not removed by talking of a Creative Power rather than a Creator God. If Mr. Spencer's new Creative Power "stands towards our general conception of things in substantially the same relation as the Creative Power of Theology," it is open to all the metaphysical dilemmas so admirably stated in "First Principles." Mr. Spencer can not have it both ways. If his Unknowable be the Creative Power and Ultimate Cause, it simply renews all the mystification of the old theologies. If his Unknowable be unknowable, then it is idle to talk of Infinite and Eternal Energy, sole Reality, All-Being, and Creative Power. This is the slip-slop of theologians which Mr. Spencer, as much as any man living, has finally torn to shreds.

In what way does the notion of Ultimate Cause avoid the difficulties in the way of First Cause, and how is Creative Power an idea more logical than Creator? And if, as Mr. Spencer says ("First Principles," p. 35), "the three different suppositions respecting the origin of things turn out to be literally unthinkable," what does he mean by asserting that a Creative Power is the one great Reality? Mr. Spencer seems to suggest that, though all idea of First Cause, of Creator, of Absolute Existence is unthinkable, the difficulty in the way of predicating them of anything is got over by asserting that the unthinkable and the unknowable is the ultimate reality. He said ("First Principles," p. 110), "every supposition respecting the genesis of the Universe commits us to alternative impossibilities of thought;" and again, "we are not permitted to know—nay, we are not even permitted to conceive—that Reality which is behind the veil of Appearance." Quite so! On that ground we have long rested firmly, accepting Mr. Spencer's teaching. It is to violate that rule if we now go on to call it Creative Power, Ultimate Cause, and the rest. It comes then to this: Mr. Spencer says to the theologians, "I can not allow you to speak of a First Cause, or a Creator, or an All-Being, or an Absolute Existence, because you mean something intelligible and conceivable by these terms, and I tell you that they stand for ideas that are unthinkable and inconceivable. But," he adds, "I have a perfect right to talk of an Ultimate Cause and a Creative Power, and an Absolute Existence, and an All-Being, because I mean nothing by these terms—at least, nothing that can be either thought of or conceived of, and I know that I am not talking of anything intelligible or conceivable. That is the faith of an Agnostic, which except a man believe faithfully he can not be saved."

Beyond the region of the knowable and the conceivable we have no right to assume an infinite energy more than an infinite series of energies, or an infinite series of infinite things or nothings. We have no right to assume one Ultimate Cause, or any cause, more than an infinite series of Causes, or something which is not Cause at all. We have no right to assume that anything beyond the knowable is eternal

or infinite, or anything else; we have no right to assume that it is the Ultimate Reality. There may be an endless circle of Realities, or there may be no Reality at all. Once leave the region of the knowable and the conceivable, and every positive assertion is unwarranted. The forms of our consciousness prove to us, says Mr. Spencer, that what lies behind the region of consciousness is not merely unknown but unknowable, that it is one, and that it is Real. The laws of mind, I reply, do not hold good in the region of the unthinkable; the forms of our consciousness can not limit the Unknowable. All positive assertions about that "which can not be brought within the forms of our finite thought" are therefore unphilosophical. We have always held this of the theological Creation, and we must hold it equally of the evolutionist Creation. Here is the difference between Positive Philosophy and Agnostic Metaphysics.

But if this Realism of the Unknowable offends against sound philosophy, the Worship of the Unknowable is abhorrent to every instinct of genuine Religion. There is something startling in Mr. Spencer's assertion that he "is not concerned to show what effect this religious sentiment will have as a moral agent." As in "First Principles," so now, he represents the business of Religion to be to keep alive the consciousness of a Mystery. The recognition of this supreme verity has been from the first, he says, the vital element of Religion. From the beginning it has dimly discerned this ultimate verity; and that supreme and ultimate verity is, that there is an inscrutable Mystery. If this be not retrogressive Religion, what is? Religion is not indeed to be discarded; but, in its final and perfect form, all that it ever has had of reverence, gratitude, love, and sympathy, is to be shrivelled up into the recognition of a Mystery. Morality, duty, goodness are no longer to be within its sphere. It will neither touch the heart of men nor mould the conduct; it will perpetually remind the intelligence that there is a great Enigma, which, it tells us, can never be solved. Not only is religion reduced to a purely mental sphere, but its task in that sphere is one practically imbecile.

Mr. Spencer complains that I called his Unknowable "an ever-present conundrum to be everlastingly given up." But he uses words almost exactly the same; he himself speaks of "the Great Enigma which he (man) knows can not be solved." The business of the religious sentiment is with "a consciousness of a Mystery that can not be fathomed." It would be difficult to find for Religion a lower and more idle part to play in human life than that of continually presenting to man a conundrum, which he is told he must continually give up. One would take all this to be a bit from "Alice in Wonderland," rather than the first chapter of "Synthetic Philosophy."

I turn to some of the points on which Mr. Spencer thinks that I misunderstand or misrepresent his meaning. I can not admit any one

of these cases. In calling the Unknowable a pure negation, I spoke from the standpoint of Religion, not of Metaphysics. It may be a logical postulate, but that of which we can know nothing, and of which we can form no conception, I shall continue to call a pure negation, *as an object of worship*, even if I am told (as I now am) that it is that "by which all things are created and sustained." Such is the view of Sir James Stephen, and of every other critic who has joined in this discussion.

With respect to Dean Mansel I made no mistake; the mistake is Mr. Spencer's—not mine. I said that of all modern theologians the Dean came the nearest to him. As we all know, in "First Principles" Mr. Spencer quotes and adopts four pages from Mansel's "Bampton Lectures." But I said "there is a gulf which separates even his all-negative *deity* from Mr. Spencer's impersonal, unconscious, unthinking, and unthinkable Energy." Mr. Spencer says that I misrepresent him and transpose his doctrine and Mansel's, because he regards the Absolute as positive and the Dean regarded it as negative. If Mr. Spencer will look at my words again, he will see that I was speaking of Mansel's Theology, not of his Ontology. I said "*deity*," not the Absolute. Mansel, as a metaphysician, no doubt spoke of the Absolute as a negative, whilst Mr. Spencer speaks of it as positive. But Mansel's idea of deity is personal, whilst Mr. Spencer's Energy is not personal. That is strictly accurate. Dean Mansel's words are, "it is our duty to think of God as personal;" Mr. Spencer's words are, "duty requires us neither to affirm nor to deny personality" of the Unknown Cause. That is to say, the Dean called his First Cause God; Mr. Spencer prefers to call it Energy. Both describe this First Cause negatively; but whilst the Dean calls it a Person, Mr. Spencer will not say that it is person, conscious, or thinking. Mr. Spencer's impression then that I misrepresented him in this matter is simply his own rather hasty reading of my words.

It is quite legitimate in a question of religion and an object of worship to speak of this Unknowable Energy, described as Mr. Spencer describes it, as "impersonal, unconscious, unthinking, and unthinkable." The distinction that, since we neither affirm nor deny of it personality, consciousness, or thought, it is not therefore impersonal, is a metaphysical subtlety. That which can not be presented in terms of human consciousness is neither personal, conscious, nor thinking, but properly unthinkable. To the ordinary mind it is a logical formula, it is apart from man, it is impersonal and unconscious. And to tell us that this conundrum is "the power which manifests itself in consciousness," that man and the world are but its products and manifestations, that it may have (for aught we know) something higher than personality and something grander than intelligence, is to talk theologico-metaphysical jargon, but is not to give the average man and woman any positive idea at all, and certainly not a religious idea.

In religion, at any rate, that which can only be described by negations is negative; that which can not be presented in terms of consciousness is unconscious.

I shall say but little about Mr. Spencer's Ghost theory as the historical source of all religion; because it is, after all, a subordinate matter, and would lead to a wide digression. I am sorry that he will not accept my (not very serious) invitation to him to modify the paradoxes thereon to be read in his "Principles of Sociology." I have always held it to be one of the most unlucky of all his sociologic doctrines, and that on psychological as well as on historical grounds. Mr. Spencer asserts that all forms of religious sentiment spring from the primitive idea of a disembodied double of a dead man. I assert that this is a rather complicated and developed form of thought; and that the simplest and earliest form of religious sentiment is the idea of the rudest savage, that visible objects around him—animal, vegetable, and inorganic—have quasi-human feelings and powers, which he regards with gratitude and awe. Mr. Spencer says that man only began to worship a river or a volcano when he began to imagine them as the abode of dead men's *spirits*. I say that he began to fear or adore them, so soon as he thought the river or the volcano had the feelings and the powers of living beings; and that was from the dawn of the human intelligence. The latter view is, I maintain, far the simpler and more obvious explanation; and it is a fault in logic to construct a complicated explanation when a simple one answers the facts. Animals think inert things of a peculiar form to be animal; so do infants. The dog barks at a shadow; the horse dreads a steam-engine; the baby loves her doll, feeds her, nurses her, and buries her. The savage thinks the river, or the mountain beside which he lives, the most beneficent, awful, powerful of beings. There is the germ of religion. To assure us that the savage has no feeling of awe and affection for the river and the mountain, until he has evolved the elaborate idea of disembodied spirits of dead men dwelling invisibly inside them, is as idle as it would be to assure us that the love and the terror of the dog, the horse, and the baby are due to their perceiving some disembodied spirit inside the shadow, the steam-engine, or the doll.

I think it a little hard that I may not hold this common-sense view of the matter, along with almost all who have studied the question, without being told that it comes of "persistent thinking along defined grooves," and that I should accept the Ghost theory of Religion were it not for my fanatical discipleship. Does not Mr. Spencer himself persistently think along defined grooves; and does not every systematic thinker do the same? But it so happens that the Ghost theory leads to conclusions that outrage common sense. If Dr. Tylor has finally adopted it, I am sorry. But it is certain that the believers in the Ghost theory as the origin of all forms of Religion are few and far between. The difficulties in the way of it are enormous. Mr.

Spencer laboriously tries to persuade us that the worship of the Sun and the Moon arose, not from man's natural reverence for these great and beautiful powers of Nature, but solely as they were thought to be the abodes of the disembodied spirits of dead ancestors. Animal worship, tree and plant worship, fetichism, the Confucian worship of heaven, all, he would have us believe, take their origin entirely from the idea that these objects contain the spirits of the dead. If this is not "persistent thinking along defined grooves," I know not what it is.

The case of China is decisive. There we have a religion of vast antiquity and extent, perfectly clear and well ascertained. It rests entirely on worship of Heaven, and Earth, and objects of Nature, regarded as organized beings, and not as the abode of human spirits. There is in the religion and philosophy of China no notion of human *spirits*, disembodied and detached from the dead person, conceived as living in objects and distinct from dead bodies. The dead are the dead; not the spiritual denizens of other things. In the face of this, the vague language of missionaries and travellers as to the beliefs of savages must be treated with caution. Mr. Spencer speaks in too confident language of his having "proved" and "disproved" and "shown" all these things in his "Descriptive Sociology" and in his "Principles of Sociology." How many competent persons has he convinced? Assuredly, for my part, I read and re-read all that he there says about the genesis of religion with amazement. We read these authorities for ourselves, and we can not see that they bear out his conclusions. It was a pity to refer to the tables in the "Descriptive Sociology," perhaps the least successful of all Mr. Spencer's works. That work is a huge file of cuttings from various travellers of all classes, extracted by three gentlemen whom Mr. Spencer employed. Of course these intelligent gentlemen had little difficulty in clipping from hundreds of books about foreign races sentences which seem to support Mr. Spencer's doctrines. The whole proceeding is too much like that of a famous lawyer who wrote a law-book, and then gave it to his pupils to find the "cases" which supported his law. It is a little suspicious that we find so often at the head of each "susperstition" of the lower races a heading in almost the same words to the effect: "Dreams, regarded as visits from the spirits of departed relations." The intelligent gentlemen employed have done their work very well; but of course one can find in this medley of tables almost any view. And I find facts which make for my view as often as any other.

Fetichism, says Mr. Spencer, is not found in the lowest races. Be that as it may, it is found wherever we can trace the germs of religion. Well, I read in the "Descriptive Sociology" that Mr. Burton, perhaps the most capable of all African travellers, declares that "fetichism is still the only faith known in East Africa." In other places, we read of the sun and moon, forests, trees, stones, snakes, and the like regarded with religious reverence by the savages of Central Africa.

"The Damaras attribute the origin of the sheep to a large stone." They regard a big tree as the origin of Damaras. "Cattle of a certain color are venerated by the Damaras." "To the Bechuanas rain appears as the giver of all good." The negro whips or throws away a worthless fetich. "The Hottentots and Bushmen shoot poisoned arrows at the lightning and throw old shoes at it." Exactly! And do these Damaras, Bechuanas, and Bushmen do this solely because they think that the sun and moon, the lightning, the rain, the trees, the cattle, and the snakes are the abodes of the disembodied spirits of their dead relatives? And do they never do this until they have evolved a developed Ghost theory?

This is more than I can accept, for all the robustness of faith which Mr. Spencer attributes to me. Whilst I find in a hundred books that countless races of Africa and the organized religion of China attribute human *qualities* to natural objects, and grow up to regard those objects with veneration and awe, I shall continue to think that fetichism, or the reverent ascription of feeling and power to natural objects, is a spontaneous tendency of the human mind. And I shall refuse, even on Mr. Spencer's high authority, and that of his three compilers, to believe that it is solely a result of a developed *Ghost theory*. To ask us to believe this as "proved" on the strength of a pile of clippings made to order is, I think, quite as droll to ordinary minds as anything Mr. Spencer can pick up out of the Positivist Calendar.—*Nineteenth Century*.

## LAST WORDS ABOUT AGNOSTICISM.

By HERBERT SPENCER.

THOSE who expected from Mr. Harrison an interesting rejoinder to my reply, will not be disappointed. Those who looked for points skilfully made, which either are, or seem to be, telling, will be fully satisfied. Those who sought pleasure from witnessing a display of literary power, will close his article gratified with the hour they have spent over it. Those only will be not altogether contented who supposed that my outspoken criticism of Mr. Harrison's statements and views, would excite him to an unusual display of that trenchant style for which he is famous; since he has, for the most part, continued the discussion with calmness. After saying thus much it may seem that some apology is needed for continuing a controversy of which many, if not most, readers, have by this time become weary. But gladly as I would leave the matter where it stands, alike to save my own time and others' attention, there are sundry motives which forbid me. Partly my excuse must be the profound importance and perennial interests of the questions raised. Partly I am prompted by the con-

sideration that it is a pity to cease just when a few more pages will make clear sundry of the issues, and leave readers in a better position for deciding. Partly it seems to me wrong to leave grave misunderstandings unrectified. And partly I am reluctant on personal grounds to pass by some of Mr. Harrison's statements unnoticed.

One of these statements, indeed, it would be imperative on me to notice, since it reflects on me in a serious way. Speaking of the "Descriptive Sociology," which contains a large part (though by no means all) of the evidence used in the "Principles of Sociology," and referring to the compilers who, under my superintendence, selected the materials forming that work, Mr. Harrison says:—

> Of course these intelligent gentlemen had little difficulty in clipping from hundreds of books about foreign races sentences which seem to support Mr. Spencer's doctrines. The whole proceeding is too much like that of a famous lawyer who wrote a law-book, and then gave it to his pupils to find the "cases" which supported his law.

Had Mr. Harrison observed the dates, he would have seen that since the compilation of the "Descriptive Sociology" was commenced in 1867 and the writing of the "Principles of Sociology" in 1874, the parallel he draws is not altogether applicable: the fact being that the "Descriptive Sociology" was commenced seven years in advance for the purpose (as stated in the preface) of obtaining adequate materials for generalizations: sundry of which, I may remark in passing, have been quite at variance with my pre-conceptions.* I think that on consideration, Mr. Harrison will regret having made so grave an insinuation without very good warrant; and he has no warrant. Charity would almost lead one to suppose that he was not fully conscious of its implications when he wrote the above passage; for he practically cancels them immediately afterwards. He says:—"But of course one can find in this medley of tables almost any view. And I find facts which make for my view as often as any other." How this last statement consists with the insinuation that what Mr. Harrison calls a "medley" of tables contains evidence vitiated by special selection of facts, it is difficult to understand. If the purpose was to justify a foregone conclusion, how does it happen that there are (according to Mr. Harrison) as many facts which make against it as there are facts which make for it?

The question here incidentally raised concerns the primitive religious idea. Which is the original belief, fetichism or the ghost-theory? The answer should profoundly interest all who care to under-

* Elsewhere Mr. Harrison contemptuously refers to the "Descriptive Sociology" as "a pile of clippings made to order." While I have been writing, the original directions to compilers have been found by my present secretary, Mr. James Bridge; and he has drawn my attention to one of the "orders." It says that all works are "to be read not with a view to any particular class of facts but with a view to all classes of facts."

stand the course of human thought; and I shall therefore not apologize for pursuing the question a little further.

Having had them counted, I find that in those four parts of the "Descriptive Sociology" which give accounts of the uncivilized races, there are 697 extracts which refer to the ghost-theory: illustrating the belief in a wandering double which goes away during sleep, or fainting, or other form of insensibility, and deserts the body for a longer period at death,—a double which can enter into and possess other persons, causing disease, epilepsy, insanity, etc., which gives rise to ideas of spirits, demons, etc., and which originates propitiation and worship of ghosts. On the other hand there are 87 extracts which refer to the worship of inanimate objects or belief in their supernatural powers. Now even did these 87 extracts support Mr. Harrison's view, this ratio of 8 to 1 would hardly justify his statement that the facts "make for my [his] view as often as any other." But these 87 extracts do not make for his view. To get proof that the inanimate objects are worshipped for themselves simply, instances must be found in which such objects are worshipped among peoples who have no ghost-theory; for wherever the ghost-theory exists it comes into play and originates those supernatural powers which certain objects are supposed to have. When by unrelated tribes scattered all over the world, we find it held that the souls of the dead are supposed to haunt the neighboring forests—when we learn that the Karen thinks "the spirits of the departed dead crowd around him;"* that the Society Islanders imagined spirits "surrounded them night and day watching every action;"† that the Nicobar people annually compel "all the bad spirits to leave the dwelling;"‡ that an Arab never throws anything away without asking forgiveness of the Efrits he may strike;"* and that the Jews thought it was because of the multitudes of spirits in synagogues that "the dress of the Rabbins become so soon old and torn through their rubbing;"‖—when we find the accompanying belief to be that ghosts or spirits are capable of going into, and emerging from, solid bodies in general, as well as the bodies of the quick and the dead; it becomes obvious that the presence of one of these spirits swarming around, and capable of injuring or benefiting living persons, becomes a sufficient reason for propitiating an object it is assumed to have entered: the most trivial peculiarity sufficing to suggest possession—such possession being, indeed, in some cases conceived as universal, as by the Eskimo, who think every object is ruled by "its or his *inuk*, which word signifies '*man*,' and also *owner* or *in-*

* "Journal of Asiatic Society of Bengal," xxiv, part ii, p. 196.

† Ellis, "Polynesian Researches," vol. i, p. 525.

‡ "Journ. As. Soc. of Ben.," xv, pp. 348, 349.

* Bastian, "Mensch," ii, 109, 113.

‖ "Supernatural Religion," 2d ed., vol. i, p. 112.

*habitant*."* Such being the case, there can be no proof that the worship of the objects themselves was primordial, unless it is found to exist where the ghost-theory has not arisen; and I know no instance showing that it does so. But while those facts given in the "Descriptive Sociology" which imply worship of inanimate objects, or ascription of supernatural powers to them, fail to support Mr. Harrison's view, because always accompanied by the ghost-theory, sundry of them directly negative his view. There is the fact that an echo is regarded as the voice of the fetich; there is the fact that the inhabiting spirit of the fetich is supposed to "enjoy the savory smell" of meat roasted before it; and there is the fact that the fetich is supposed to die and may be revived. Further, there is the summarized statement made by Beecham, an observer of fetichism in the region where it is supposed to be specially exemplified, who says that:—

> The fetiches are believed to be spiritual, intelligent beings, who make the remarkable objects of nature their residence, or enter occasionally into the images and other artificial representations, which have been duly consecrated by certain ceremonies. . . . They believe that these fetiches are of both sexes, and that they require food.

These statements are perfectly in harmony with the conclusion that fetichism is a development of the ghost-theory, and altogether incongruous with the interpretation of fetichism which Mr. Harrison accepts from Comte.

Already I have named the fact that Dr. Tylor, who has probably read more books about uncivilized peoples than any Englishman living or dead, has concluded that fetichism is a form of spirit-worship, and that (to give quotations relevant to the present issue)

> To class an object as a fetish, demands explicit statement that a spirit is considered as embodied in it or acting through it or communicating by it.† = Orthodoxy
>
> . . . A further stretch of imagination enables the lower races to associate the souls of the dead with mere objects.‡
>
> . . . The spirits which enter or otherwise attach themselves to objects may be human souls. Indeed, one of the most natural cases of the fetish-theory is when a soul inhabits or haunts the relics of its former body.*

Here I may add an opinion to like effect which Dr. Tylor quotes from the late Prof. Waitz, also an erudite anthropologist. He says:—

> According to his [the negro's] view, a spirit dwells or can dwell in every sensible object, and often a very great and mighty one in an insignificant thing. This spirit he does not consider as bound fast and unchangeably to the corporeal thing it dwells in, but it has only its usual or principal abode in it.‖

* Dr. Henry Rink, "Tales and Traditions of the Eskimo," p. 37.
† Tylor, "Primitive Culture," vol. ii, p. 133.
‡ Ibid., p. 139. * Ibid., p 137. ‖ Ibid., p. 144.

Space permitting I might add evidence furnished by Sir Alfred Lyall, who, in his valuable papers published in the "Fortnightly Review" years ago on religion in India, has given the results of observations made there. Writing to me from the North-West provinces under date August 1, in reference to the controversy between Mr. Harrison and myself, he incloses copies of a letter and accompanying memorandum from the magistrate of Gorakhpur, in verification of the doctrine that ghost-worship is the "chief source and origin" of religion. Not, indeed, that I should hope by additional evidence to convince Mr. Harrison. When I point to the high authority of Dr. Tylor as on the side of the ghost-theory, Mr. Harrison says—"If Dr. Tylor has finally adopted it, I am sorry." And now I suppose that when I cite these further high authorities on the same side, he will simply say again "I am sorry," and continue to believe as before.

In respect of the fetichism distinguishable as nature-worship, Mr. Harrison relies much on the Chinese. He says :—

> The case of China is decisive. There we have a religion of vast antiquity and extent, perfectly clear and well ascertained. It rests entirely on worship of Heaven, and Earth, and objects of Nature, regarded as organized beings, and not as the abode of human spirits.

Had I sought for a case of "a religion of vast antiquity and extent, perfectly clear and well ascertained," which illustrates origin from the ghost-theory, I should have chosen that of China; where the State-religion continues down to the present day to be an elaborate ancestor-worship, where each man's chief thought in life is to secure the due making of sacrifices to his ghost after death, and where the failure of a first wife to bear a son who shall make these sacrifices, is held a legitimate reason for taking a second. But Mr. Harrison would, I suppose, say that I had selected facts to fit my hypothesis. I therefore give him, instead, the testimony of a bystander. Count D'Alviella has published a *brochure* concerning these questions on which Mr. Harrison and I disagree.* In it he says on page 15 :—

> La thèse de M. Harrison, au contraire,—que l'homme aurait commencé par l'adoration d'objets matériels "franchement regardés comme tels,"—nous paraît absolument contraire au raisonnement et à l'observation. Il cite, à titre d'exemple, l'antique religion de la Chine, "entièrement basée sur la vénération de la Terre, du Ciel et des Ancêtres, considérés objectivement et non comme la résidence d'êtres immatériels." [This sentence is from Mr. Harrison's first article, not from his second.] C'est là jouer de malheur, car, sans même insister sur ce que peuvent être des Ancêtres "considérés objectivement," il se trouve précisément que la religion de l'ancien empire Chinois est le type le plus parfait de l'animisme organisé et qu'elle regarde même les objets matériels, dont elle fait ses dieux, comme la manifestation inséparable, l'enveloppe ou même le corps d'esprits invisibles. [Here in a note Count D'Alviella refers to authorities,

* "Harrison contre Spencer sur la Valeur Religieuse de L'Inconnaissable," par le Cte. Goblet D'Alviella. Paris, Ernest Leroux.

"notamment Tiele, 'Manuel de l'Histoire des Religions,' traduit par M. Maurice Vernes, Liv. II, et dans la 'Revue de l'Histoire des Religions,' la 'Religion de l'ancien empire Chinois' par M. Julius Happel (t. IV, no. 6)."]

Whether Mr. Harrison's opinion is or is not changed by this array of counter-opinion, he may at any rate be led somewhat to qualify his original statement that "Nothing is more certain than that man everywhere started with a simple worship of natural objects."

I pass now to Mr. Harrison's endeavor to rebut my assertion that he had demolished a *simulacrum* and not the reality.

I pointed out that he had inverted my meaning by representing as negative that which I regarded as positive. What I have everywhere referred to as the All-Being, he named the All-Nothingness. What answer does he make when I show that my position is exactly the reverse of that alleged? He says that while I am "dealing with transcendental conceptions, intelligible only to certain trained metaphysicians," he is "dealing with religion as it affects the lives of men and women in the world;" that "to ordinary men and women, an unknowable and inconceivable Reality is practically an Unreality;" and that thus all he meant to say was that the "Everlasting Yes" of the "evolutionist," "is in effect on the public a mere Everlasting No" (p. 354). Now compare these passages in his last article with the following passages in his first article:—"One would like to know how much of the Evolutionist's day is consecrated to seeking the Unknowable in a devout way, and what the religious exercises might be. How does the man of science approach the All-Nothingness" (p. 502)? Thus we see that what was at first represented as the unfitness of the creed considered as offered to the select is now represented as its unfitness considered as offered to the masses. What were originally the "Evolutionist" and the "man of science" are now changed into "ordinary men and women" and "the public;" and what was originally called the All-Nothingness has become an "inconceivable Reality." The statement which was to be justified is not justified, but something else is justified in its stead.

Thus it is, too, with the paragraph in which Mr. Harrison seeks to disprove my assertion that he had exactly transposed the doctrines of Dean Mansel and myself, respecting our consciousness of that which transcends perception. He quotes his original words, which were, "there is a gulf which separates even his all-negative *deity* from Mr. Spencer's impersonal, unconscious, unthinkable Energy." And he then goes on to say: "I was speaking of Mansel's Theology, not of his Ontology. I said '*deity*,' not the Absolute." Very well; now let us see what this implies. Mansel, as I was perfectly well aware, supplements his ontological nihilism with a theological realism. That which in his ontological argument he represents as a mere "negation of conceivability," he subsequently reasserts on grounds of faith, and clothes

with the ordinarily ascribed divine attributes. Which of these did I suppose Mr. Harrison meant by "all-negative deity"? I was compelled to conclude he meant that which in the ontological argument was said to be a "negation of conceivability." How could I suppose that by "all-negative deity" Mr. Harrison meant the deity which Dean Mansel as a matter of "duty" rehabilitates and worships in his official capacity as priest? It was a considerable stretch of courage on the part of Mr. Harrison to call the deity of the established church an "all-negative deity." Yet in seeking to escape from the charge of misrepresenting me he inevitably does this by implication.

In his second article Mr. Harrison does not simply ascribe to me ideas which are wholly unlike those my words express, but he ascribes to me ideas I have intentionally excluded. When justifying my use of the word "proceed," as the most colorless word I could find to indicate the relation between the knowable manifestations present to perception and the Unknowable Reality which transcends perception, I incidentally mentioned, as showing that I wished to avoid those theological implications which Mr. Harrison said were suggested, that the words originally written were "created and sustained;" and that though in the sense in which I used them the meanings of these words did not exceed my thought, I had erased them because "the ideas associated with these words might mislead." Yet Mr. Harrison speaks of these erased words as though I had finally adopted them, and saddles me with the ordinary connotations. If Mr. Harrison defends himself by quoting my words to the effect that the Inscrutable Existence manifested through phenomena "stands towards our general conception of things in substantially the same relation as does the Creative Power asserted by Theology;" then I point to all my arguments as clearly meaning that when the attributes and the mode of operation ordinarily ascribed to "that which lies beyond the sphere of sense" cease to be ascribed, "that which lies beyond the sphere of sense" will bear the same relation as before to that which lies within it, in so far that it will occupy the same relative position in the totality of our consciousness: no assertion being made concerning the mode of connection of the one with the other. Surely when I had deliberately avoided the word "create" to express the connection between noumenal cause and the phenomenal effect, because it might suggest the ordinary idea of a creating power separate from the created thing, Mr. Harrison was not justified in basing arguments against me on the assumption that I had used it.

But the course in so many cases pursued by him of fathering upon me ideas incongruous with those I have expressed, and making me responsible for the resulting absurdities, is exhibited in the most extreme degree by the way in which he has built up for me a system of beliefs and practices. In his first article occur such passages as—"seeking the Unknowable in a devout way" (p. 502); can any one

"hope anything of the Unknowable or find consolation therein?" (p. 503); and to a grieving mother he represents me as replying to assuage her grief, "Think on the Unknowable" (p. 503). Similarly in his second article he writes, "to tell them that they are to worship this Unknowable is equivalent to telling them to worship nothing" (p. 357); "the worship of the Unknowable is abhorrent to every instinct of genuine religion" (p. 360); "praying to the Unknowable at home" (p. 376); and having in these and kindred ways fashioned for me the observances of a religion which he represents me as "proposing," he calls it "one of the most gigantic paradoxes in the history of thought" (p. 355). So effectually has Mr. Harrison impressed everybody by these expressions and assertions, that I read in a newspaper —"Mr. Spencer speaks of the 'absurdities of the Comtean religion,' but what about his own peculiar cult?"

Now the whole of this is a fabric framed out of Mr. Harrison's imaginations. I have nowhere "proposed" any "object of religion." I have nowhere suggested that any one should "worship this Unknowable." No line of mine gives ground for inquiring how the Unknowable is to be sought "in a devout way," or for asking what are "the religious exercises;" nor have I suggested that any one may find "consolation therein." Observe the facts. At the close of my article "Religion; a Retrospect and Prospect," I pointed out to "those who think that science is dissipating religious beliefs and sentiments," "that whatever of mystery is taken from the old interpretation is added to the new;" increase rather than diminution being the result. I said that in perpetually extending our knowledge of the Universe, concrete science "enlarges the sphere for religious sentiment;" and that progressing knowledge is "accompanied by an increasing capacity for wonder." And in my second article, in further explanation, I have represented my thesis to be "that whatever components of this [the religious] sentiment disappear, there must ever survive those which are appropriate to the consciousness of a Mystery that can not be fathomed and a Power that is omnipresent." This is the sole thing for which I am responsible. I have advocated nothing; I have proposed no worship; I have said nothing about "devotion," or "prayer," or "religious exercises," or "hope," or "consolation." I have simply affirmed the permanence of certain components in the consciousness which "is concerned with that which lies beyond the sphere of sense." If Mr. Harrison says that this surviving sentiment is inadequate for what he thinks the purposes of religion, I simply reply—I have said nothing about its adequacy or inadequacy. The assertion that the emotions of awe and wonder form but a fragment of religion, leaves me altogether unconcerned: I have said nothing to the contrary. If Mr. Harrison sees well to describe the emotions of awe and wonder as "some rags of religious sentiment surviving" (p. 358), it is not incumbent on me to disprove the fitness of his expression. I am respon-

sible for nothing whatever beyond the statement that these emotions will survive. If he shows this conclusion to be erroneous, then indeed he touches me. This, however, he does not attempt. Recognizing though he does that this is all I have asserted, and even exclaiming "is that all!" (p. 358), he nevertheless continues to father upon me a number of ideas quoted above, which I have neither expressed nor implied, and asks readers to observe how grotesque is the fabric formed of them.

I enter now on that portion of Mr. Harrison's last article to which is specially applicable its title "Agnostic Metaphysics." In this he recalls sundry of the insuperable difficulties set forth by Dean Mansel, in his "Bampton Lectures," as arising when we attempt to frame any conception of that which lies beyond the realm of sense. Accepting, as I did, Hamilton's general arguments which Mansel applied to theological conceptions, I contended in "First Principles" that their arguments are valid, only on condition that that which transcends the relative is regarded not as negative, but as positive; and that the relative itself becomes unthinkable as such in the absence of a postulated non-relative. Criticisms on my reasoning allied to those made by Mr. Harrison, have been made before, and have before been answered by me. To an able metaphysician, the Rev. James Martineau, I made a reply which I may be excused here for reproducing, as I can not improve upon it:

Always implying terms in relation, thought implies that both terms shall be more or less defined; and as fast as one of them becomes indefinite, the relation also becomes indefinite, and thought becomes indistinct. Take the case of magnitudes. I think of an inch; I think of a foot; and having tolerably definite ideas of the two, I have a tolerably definite idea of the relation between them. I substitute for the foot a mile; and being able to represent a mile much less definitely, I can not so definitely think of the relation between an inch and a mile—can not distinguish it in thought from the relation between an inch and two miles, as clearly as I can distinguish in thought the relation between an inch and one foot from the relation between an inch and two feet. And now if I endeavor to think of the relation between an inch and the 240,000 miles from here to the Moon, or the relation between an inch and the 92,000,000 miles from here to the Sun, I find that while these distances, practically inconceivable, have become little more than numbers to which I frame no answering ideas, so, too, has the relation between an inch and either of them become practically inconceivable. Now this partial failure in the process of forming thought-relations, which happens even with finite magnitudes when one of them is immense, passes into complete failure when one of them can not be brought within any limits. The relation itself becomes unrepresentable at the same time that one of its terms becomes unrepresentable. Nevertheless, in this case it is to be observed that the almost-blank form of relation preserves a certain qualitative character. It is still distinguishable as belonging to the consciousness of extensions, not to the consciousnesses of forces or durations; and in so far remains a vaguely-identifiable relation. But now suppose we ask what happens when one term of the

relation has not simply magnitude having no known limits, and duration of which neither beginning nor end is cognizable, but is also an existence not to be defined? In other words, what must happen if one term of the relation is not only quantitatively but also qualitatively unrepresentable? Clearly in this case the relation does not simply cease to be thinkable except as a relation of a certain class, but it lapses completely. When one of the terms becomes wholly unknowable, the law of thought can no longer be conformed to; both because one term can not be present, and because relation itself can not be framed. . . . In brief, then, to Mr. Martineau's objection I reply, that the insoluble difficulties he indicates arise here, as elsewhere, when thought is applied to that which transcends the sphere of thought; and that just as when we try to pass beyond phenomenal manifestations to the Ultimate Reality manifested, we have to symbolize it out of such materials as the phenomenal manifestations give us; so we have simultaneously to symbolize the connection between this Ultimate Reality and its manifestations, as somehow allied to the connections among the phenomenal manifestations themselves. The truth Mr. Martineau's criticism adumbrates, is that the law of thought fails where the elements of thought fail; and this is a conclusion quite conformable to the general view I defend. Still holding the validity of my argument against Hamilton and Mansel, that in pursuance of their own principle the Relative is not at all thinkable *as such*, unless in contradistinction to some existence posited, however vaguely, as the other term of a relation, conceived however indefinitely; it is consistent on my part to hold that in this effort which thought inevitably makes to pass beyond its sphere, not only does the product of thought become a dim symbol of a product, but the process of thought becomes a dim symbol of a process; and hence any predicament inferable from the law of thought can not be asserted.*

Thus then criticisms like this of Mr. Martineau, often recurring in one shape or other, and now again made by Mr. Harrison, do not show the invalidity of my argument, but once more show the imbecility of human intelligence when brought to bear on the ultimate question. Phenomenon without noumenon is unthinkable; and yet noumenon can not be thought of in the true sense of thinking. We are at once obliged to be conscious of a reality behind appearance, and yet can neither bring this consciousness of reality into any shape, nor can bring into any shape its connection with appearance. The forms of our thought, moulded on experiences of phenomena, as well as the connotations of our words formed to express the relations of phenomena, involve us in contradictions when we try to think of that which is beyond phenomena; and yet the existence of that which is beyond phenomena is a necessary datum alike of our thoughts and our words. We have no choice but to accept a formless consciousness of the inscrutable.

I can not treat with fulness the many remaining issues. To Mr. Harrison's statement that it was uncandid in me to implicate him with the absurdities of the Comtean belief and ritual, notwithstanding his public utterances, I reply that whereas ten years ago I was led to think he gave but a qualified adhesion to Comte's religious doctrine, such

* "Essays," vol. iii, pp. 293–296.

public utterances of his as I have read of late years, fervid in their eloquence, persuaded me that he had become a much warmer adherent. On his summary mode of dealing with my criticism of the Comtean creed some comment is called for. He remarks that there are "good reasons for declining to discuss with Mr. Spencer the writings of Comte;" and names, as the first, "that he knows [I know] nothing whatever about them" (p. 365). Now as Mr. Harrison is fully aware that thirty years ago I reviewed the English version of those parts of the Positive Philosophy which treat of Mathematics, Astronomy and Physics; and as he has referred to the pamphlet in which, ten years later, I quoted a number of passages from the original to signalize my grounds of dissent from Comte's system; I am somewhat surprised by this statement, and by the still more emphatic statement that to me "the writings of Comte are, if not the Absolute Unknowable, at any rate the Absolute Unknown" (p. 365). Doubtless these assertions are effective; but like many effective assertions they do not sufficiently recognize the facts. The remaining statements in this division of Mr. Harrison's argument, I pass over: not because answers equally adequate with those I have thus far given do not exist, but because I can not give them without entering upon personal questions which I prefer to avoid.

On the closing part of "Agnostic Metaphysics" containing Mr. Harrison's own version of the Religion of Humanity, I have to remark, as I find others remarking, that it amounts, if not to an abandonment of his original position, still to an entire change of front. Anxious, as he has professed himself, to retain the "magnificent word Religion" (p. 504), it now appears that when "the Religion of Humanity" is spoken of, the usual connotations of the word are to be in large measure dropped: to give it these connotations is "to foist in theological ideas where none are suggested by us" (p. 369). While, in his first article, one of the objections raised to the "neo-theisms" as well as "the Unknowable," was that there is offered "no relation whatever between worshipper and worshipped" (p. 505) (an objection tacitly implying that Mr. Harrison's religion supplies this relation), it now appears that Humanity is not to be worshipped in any ordinary sense; but that by worship is simply meant "intelligent love and respect for our human brotherhood," and that "in plain words, the Religion of Humanity means recognizing your duty to your fellow-man on human grounds" (p. 369). Certainly this is much less than what I and others supposed to be included in Mr. Harrison's version of the Religion of Humanity. If he preaches nothing more than an ecstatic philanthropy, few will object; but most will say that his name for it conveyed to them a much wider meaning. Passing over all this, however, I am concerned chiefly to point out another extreme misrepresentation made by Mr. Harrison when discussing my criticism of Comte's assertion that "veneration and gratitude" are due to the

Great Being Humanity. After showing why I conceive "veneration and gratitude" are not due to Humanity, I supposed an opponent to exclaim (putting the passage within quotation-marks), "But surely 'veneration and gratitude' are due somewhere," since civilized society with all its products "must be credited to some agency or other." [This apostrophe, imagined as coming from a disciple of Comte, Mr. Harrison, on p. 373, actually represents as made in my own person!] To this apostrophe I have replied (p. 22) that "if 'veneration and gratitude' are due at all, they are due to that Ultimate Cause from which Humanity, individually and as a whole, in common with all other things has proceeded." Whereupon Mr. Harrison changes my hypothetical statement into an actual statement. He drops the "*if*," and represents me as positively affirming that "veneration and gratitude" are due somewhere: saying that Mr. Spencer "lavishes his 'veneration and gratitude,' called out by the sum of human civilization, upon his Unknowable and Inconceivable Postulate" (p. 373). I should have thought that even the most ordinary reader, much more Mr. Harrison, would have seen that the argument is entirely an argument *ad hominem*. I deliberately and carefully guarded myself by the "*if*" against the ascription to me of any opinion, one way or the other: being perfectly conscious that much is to be said for and against. The optimist will unhesitatingly affirm that veneration and gratitude are due; while by the pessimist it will be contended that they are not due. One who dwells exclusively on what Emerson calls "the saccharine" principle in things, as illustrated for example in the adaptation of living beings to their conditions—the becoming callous to pains that have to be borne, and the acquirement of liking for labors that are necessary—may think there are good reasons for veneration and gratitude. Contrariwise, these sentiments may be thought inappropriate by one who contemplates the fact that there are some thirty species of parasites which prey upon man, possessing elaborate appliances for maintaining their hold on or within his body, and having enormous degrees of fertility proportionate to the small individual chances their germs have of getting into him and torturing him. Either view may be supported by masses of evidence; and knowing this I studiously avoided complicating the issue by taking either side. As any one may see who refers back, my sole purpose was that of showing the absurdity of thinking that "veneration and gratitude" are due to the product and not to the producer. Yet Mr. Harrison, having changed my proposition "*if* they are due, etc.," into the proposition "they are due, etc.," laughs over the contradictions in my views which he deduces, and to which he time after time recurs, commenting on my "astonishing perversity."

In this division of Mr. Harrison's article occur five other cases in which, after his manner, propositions are made to appear untenable or ludicrous; though any one who refers to them as expressed by me will

find them neither the one nor the other. But to show all this would take much trouble to small purpose. Indeed, I must here close the discussion, so far as my own desistence enables me. It is a wearisome and profitless business, this of continually going back on the record, now to show that the ideas ascribed to me are not the ideas I expressed, and now to show that the statements my opponent defends are not the statements he originally made. A controversy always opens side issues. Each new issue becomes the parent of further ones. The original questions become obscured in a swarm of collateral questions; and energies, in my case ill-spared, are wasted to little purpose.

Before closing, however, let me again point out that nothing has been said which calls for change of the views expressed in my first article.

Setting out with the statement that "unlike the ordinary consciousness, the religious consciousness is concerned with that which lies beyond the sphere of sense," I went on to show that the rise of this consciousness begins among primitive men with the belief in a double belonging to each individual, which, capable of wandering away from him during life, becomes his ghost or spirit after death; and that from this idea of a being eventually distinguished as supernatural, there develop, in course of time, the ideas of supernatural beings of all orders up to the highest. Mr. Harrison has alleged that the primitive religion is not belief in, and propitiation of, the ghost, but is worship of "physical objects treated frankly as physical objects" (p. 498). That he has disproved the one view and proved the other, no one will, I think, assert. Contrariwise, he has given occasion for me to cite weighty authorities against him.

Next it was contended that in the assemblage of supernatural beings thus originating in each tribe, some, derived from chiefs, were superior to others; and that, as the compounding and re-compounding of tribes gave origin to societies having social grades and rulers of different orders, there resulted that conception of a hierarchy of ghosts or gods which polytheism shows us. Further it was argued that while, with the growth of civilization and knowledge, the minor supernatural agents became merged in the major supernatural agent, this single great supernatural agent, gradually losing the anthropomorphic attributes at first ascribed, has come in our days to retain but few of them; and, eventually losing these, will then merge into a consciousness of an omnipresent power to which no attributes can be ascribed. This proposition has not been contested.

In pursuance of the belief that the religious consciousness naturally arising, and thus gradually transformed, would not disappear wholly, but that "however much changed it must continue to exist," it was argued that the sentiments which had grown up around the conception of a personal God, though modified when that conception was modi-

fied into the conception of a power which can not be known or conceived, would not be destroyed. It was held that there would survive, and might even increase, the sentiments of wonder and awe in presence of a universe of which the origin and nature, meaning and destiny, can neither be known nor imagined; or that, to quote a statement afterwards employed, there must survive those emotions "which are appropriate to the consciousness of a mystery that can not be fathomed and a power that is omnipresent." This proposition has not been disproved; nor, indeed, has any attempt been made to disprove it.

Instead of assaults on these propositions to which alone I am committed, there have been assaults on various propositions gratuitously attached to them; and then the incongruities evolved have been represented as incongruities for which I am responsible.

I end by pointing out as I pointed out before, that "while the things I have said have not been disproved, the things which have been disproved are things I have not said."—*Nineteenth Century.*

## INFLUENCES DETERMINING SEX.*

By Professor W. K. BROOKS,
of Johns Hopkins University.

OF the many writers upon this subject, some have approached it with such an imperfect and narrow acquaintance with the facts that their contributions are of no interest to the scientific student; while other writers have allowed some minor generalizations to assume such prominence that their papers are of little value in themselves. The subject has an especial fascination for many minds, apart from its very great scientific interest, and we can, therefore, understand that the fugitive literature is somewhat in disrepute among students.

In Düring's papers, however, we find a remarkable combination of the two elements of scientific research: thorough observation and accumulation of evidence, and reflection upon its hidden significance. Although they contain comparatively little original observation, they are remarkable for the encyclopedic information which the author has collected from all sources. In many cases his generalizations are based upon observations which run up into the millions, and, even where the reader is not prepared to accept his conclusions, he will find in the papers a mine of recorded facts.

Having shown that there is in each species of animals or plants a

* "On the Laws which determine the Sex of the Embryo in Mankind, in Animals, and in Plants." Carl Düring, "Jenaische Zeitschrift," xvi, iii, 1883, p. 428; and xvii, 1884, pp. 592–940.

constant average ratio between the sexes adapted to the conditions of life, he gives his reasons for believing that this ratio is not determined by any inner law, but by the influence of external conditions, which act sometimes upon the parent organism, sometimes upon the egg before fertilization, sometimes upon the developing egg or embryo, and sometimes, as in the case of many plants, upon the mature organism. He also believes that the character of the influence thus exerted by external conditions has been determined for the good of each species —by natural selection.

He treats, in the first part of his paper, of those conditions which act upon the two parents in opposite ways, and he summarizes his conclusions as follows: "*Each species has acquired, through natural selection, the useful property, in virtue of which any deviation from the average ratio between the sexes is corrected by an increased number of births of the deficient sex, or a decreased number of births of the sex which is in excess.*"

We have space for only two of the many illustrations which he quotes to prove the existence of this law, and for further proof must refer the reader to the long tables of statistics in the original paper.

As the result of nearly a million observations of the birth of colts, he shows that, as the number of mares put to a stallion in a year is increased, there is a corresponding and regular increase in the number of male colts as compared with the female colts, and he gives the following summary:

| Number of mares to one stallion. | Number of colts. | | Number of male to each one hundred female colts. |
|---|---|---|---|
| | Male. | Female. | |
| 20 to 34..... | 29,023 | 29,934 | 96·94 |
| 35 to 39..... | 44,911 | 46,493 | 96·60 |
| 40 to 44..... | 66,573 | 69,045 | 96·42 |
| 45 to 49..... | 69,774 | 72,073 | 96·81 |
| 50 to 54..... | 69,972 | 71,461 | 97·92 |
| 55 to 59..... | 75,493 | 74,912 | 100·77 |
| 60 or more..... | 71,407 | 70,569 | 101·19 |
| Total ..... | 427,153 | 434,487 | 98·31 |

In three cases where the power of parthenogenetic reproduction has been acquired as a compensation for the absence of males, the parthenogenetic eggs give rise either universally, or in the vast majority of cases, to males.

For instance, as bees destroy the males after they have been rendered unnecessary by the fertilization of the queen, they are exposed to the danger that when males are needed none may exist, and there can be no doubt that the power of parthenogenetic reproduction has been acquired by bees as a compensating adjustment.

When the nuptial flight of the queen is delayed by accident, or by the intervention of the breeder, the effect is, of course, equivalent

to a scarcity of males, and in such a case more male larvæ than usual are produced; while early fertilization, which is a sign of the abundance of males, results, according to Huber, in an excess of female births.

Any influence which is equivalent to a lack of individuals of one sex acts, according to Düring, to produce an excess of births of that sex, although there may be an actual deficiency.

Thus, when the queen-bee is restrained by confinement, or by the lack of wings, from the nuptial flight, or when the seminal receptacle has been removed by accident or by an operation, or when the contained semen has been killed by frost or exhausted, only males are produced.

Something of the same kind has been observed in man, and the fact that a war, which carries most of the men away from their homes, is followed by an unusually great number of male births, has been recorded by many observers.

The second part of the paper, which will be found by far the most interesting to the scientific student, treats of those influences which act in the same way upon both parents, and the author's conclusion may be summarized as follows:

The power to regulate fertility according to the means of subsistence would be of use to the organism, and since the female has gradually acquired, through division of labor, the function of providing the material for the growth of the young, an excess of females is a condition of rapid multiplication. We might therefore expect, what we actually find to be the case, that organisms have gradually acquired, through natural selection, the power to produce an excess of females in time of plenty, and in a season of scarcity of food an excess of males.

I think, however, that careful examination of the evidence which Düring has brought together will show that he has stated his generalization in too narrow terms, and I think his facts will prove the following: *A favorable environment causes an excess of female births, and an unfavorable environment an excess of male births.*

It is true that abundance or scarcity of food is one of the most important elements of that whole which makes up the *environment* of an organism, and in most of the cases which Düring quotes it is the controlling factor; but he gives many cases, some of which will be noted further on, where a variation in other conditions of life has produced the same effect, causing an excess of male births when unfavorable, and an excess of female births when favorable.

In the case of man, the conditions of life are so much under control that it is difficult to state just what constitutes a favorable environment, but I think we may conclude that, as a general rule, an environment which produces a high birth-rate is favorable, and *vice versa.* Now, Düring gives many tables to show that, among mankind, the

number of female births, as compared with the number of male births, increases as the birth-rate increases.

At the Cape of Good Hope the Boers are very prolific—six or seven is a small family, and from twelve to twenty children are not unusual; while the badly nourished and overworked Hottentots seldom have more than three children, and many of the women are barren, and Quetelet says that in 1813–'20 the free whites gave birth to 6,604 boys and 6,789 girls, or 97·2 boys to every 100 girls; while during the same time the Hottentot slaves produced 2,936 boys and 2,826 girls, or 103·9 boys to each 100 girls.

The birth-rate is higher in towns than in the country, and more boys are born for each hundred girls in the country than in the towns. Thus, in Prussia, in 1881, the number of boy-births for each 100 girls was 106·36.

| | |
|---|---|
| In Berlin it was | 105·70 |
| In large towns it was | 105·72 |
| In middle towns it was | 105·44 |
| In small towns it was | 106·14 |
| In the country it was | 106·62 |

This table shows that in all the towns the ratio of boys was below the average for the whole of Prussia, and that in Berlin it was very much below the average.

Ploss was the first to point out that there is an excess of female births in time of prosperity, and he found that in Saxony the ratio of boy-births rose and fell with the price of food, and that the variation was most marked in the country.

It is well known that the number of conceptions among mankind is greater at some seasons of the year than at others, and from a record of nearly 10,000,000 births Düring has compiled the following table, which shows that the ratio of boy-births is greatest in three months when the birth-rate is smallest:

| Conception. Birth. | April. January. | May. February. | June. March. | July. April. | August. May. | September. June. | October. July. |
|---|---|---|---|---|---|---|---|
| Boys | 484,443 | 451,750 | 484,786 | 450,272 | 446,642 | 419,541 | 439,685 |
| Girls | 455,847 | 425,091 | 457,702 | 424,740 | 420,867 | 392,928 | 411,888 |
| Total | 940,290 | 876,841 | 942,488 | 875,012 | 867,509 | 812,469 | 851,573 |
| Ratio | 106·27 | 106·27 | 105·92 | 106·01 | 106·02 | 106·77 | 106·75 |

| Conception. Birth. | November. August. | December. September. | January. October. | February. November. | March. December. | Whole year. |
|---|---|---|---|---|---|---|
| Boys | 458,385 | 479,023 | 468,337 | 452,894 | 464,024 | 5,499,782 |
| Girls | 431,192 | 452,045 | 440,447 | 426,343 | 435,382 | 5,174,472 |
| Total | 889,577 | 931,068 | 908,784 | 879,237 | 899,404 | 10,678,254 |
| Ratio | 106·31 | 105·97 | 106·33 | 106·23 | 106·58 | 106·287 |

From this table it will be seen that in June, the month when the birth-rate was smallest, the ratio of boys to each 100 girls was highest, and very much above the average for the whole year; while in March, the month when the birth-rate was greatest, the ratio of boys was smallest.

More than 6,000,000 births took place in the seven months when the ratio of boys was below the average for the year, and only 4,000,000 in the five months when it was above the average; and the table shows clearly that an increase in prosperity, as measured by the birth-rate, is accompanied by a decrease in the ratio of boy-births, and *vice versa*.

Among the lower animals, satisfactory statistics are wanting; but Düring states that, while domesticated animals are much more prolific than their wild allies, there is also a much greater preponderance of female births; that when animals are taken from a warm to a cold climate, the ratio of male births increases; and that leather-dealers say that they obtain most female skins from fertile countries where the pastures are rich, and most male skins from more barren regions; and he thinks we may safely conclude that the lower animals, as well as man, give birth to the greatest number of females when placed in a favorable environment, and to most males in an unfavorable environment.

An extreme instance is furnished by those animals which, during the seasons when food is abundant, lose the power to copulate and multiply parthenogenetically at a marvelous rate of increase, giving birth to generation after generation of parthenogenetic females, so long as the environment remains favorable, but giving birth, as soon as the conditions of life become less favorable, to males and to females which require fertilization.

The cladocera and aphides furnish the most striking instances of this kind of parthenogenesis, which has apparently been acquired, not to secure fertilization, but to enable the animals to utilize to the utmost the conditions which are most favorable to them, and to expand and contract their numbers in conformity to changes in their environment.

Among the parthenogenetic cladoceras both males and females are to be found in the fall, and a few males are found in the early spring; but during the warm months of spring and summer only females are found. These multiply very rapidly through the summer by parthenogenesis, generation after generation, and they differ from the females which are fertilized by a male in many features, all of which are of such a character as to render the parthenogenetic females unusually fertile.

They produce small eggs, which are discharged from the ovary while immature, and are nourished in a vascular broad pouch. They have little or no yolk; they are not protected by a hard shell, and they develop immediately into parthenogenetic females, which mature

very rapidly, and in some cases, as in evadne, produce eggs before they themselves are born. All their peculiarities are of such a character as to secure the greatest possible fertility; and thus to enable the animals to avail themselves, to the utmost, of the abundant supply of food.

Ramdohr found that a single isolated female daphnia produced 190 young in nineteen days, and he computed the number of descendents, at the end of sixty days, to be 1,291,370,075.

As the supply of food begins to fail in the fall, males are born, and the females produce the so-called *winter eggs*, which do not develop unless they are fertilized. These are few in numbers, much larger than the summer eggs, and they are incased in protecting shells. Their purpose is not to multiply the race, but to carry a few individuals through the winter, and over to the next season of plenty. They are slowly matured in the ovary, and contain an abundant supply of food-yolk. They are not nourished in a broad chamber, and in many cases they have, in addition to the proper shell, an extra covering or ephipium, formed out of part of the integument of the parent. In daphnella three summer eggs are matured, at one time, in each ovary; but the animal produces only one winter egg, which is seven tenths as long as the whole body.

While the abundance or lack of food is a very important factor in determining the absence or presence of males, it is not the only one. Kurg found a few males in mid summer, but only in pools which were nearly dried up; and he was thus induced to attempt the artificial production of males. He was so successful that he obtained the males of forty species, in all of which the males had previously been unknown. He proved that any unfavorable change in the water causes the production of males, which appear as it dries up, as its chemical constitution changes, when it acquires an unfavorable temperature, or in general when there is a decrease in prosperity.

From these observations and from many others quoted by Düring, I think we may safely conclude that among animals and plants, as well as in mankind, *a favorable environment causes an excess of female births, and an unfavorable environment an excess of male births.*

Now, what is the reason for this law? If the welfare of the species can be secured, under a favorable environment, by females alone, why are males needed when the environment becomes unfavorable?

I have tried to show, in another place, from evidence of another kind, that the female is the conservative factor in reproduction, and that new variations are caused by the influence of the male. While the environment remains favorable no change is needed, but, as the conditions of life become unfavorable, variation becomes necessary to restore the adjustment, and I believe that we have, in Düring's results, an exhibition of one of the most wonderful and far-reaching of all the adaptations of Nature—an adaptation in virtue of which each organ-

ism tends to remain stationary as long as no change is needed, and to vary when variation is demanded.

That this is the true view is shown, I think, by the contrast between domesticated animals and captive animals. The fact that an animal has become domesticated shows that it finds in captivity a favorable environment, and Düring says that domesticated animals are unusually fertile, and that they produce an excess of females. Animals which are kept as captives in menageries and gardens have, as a rule, no fitness for domestication, and their conditions of life are unfavorable. Geoffroy Saint-Hilaire says that individuals born in menageries are usually male, while skins sent to museums are usually female, and that the attempt to domesticate a wild animal increases the number of male births. Düring states that captive birds of prey and carnivorous mammals are very infertile, and that the young are nearly always males.

The wild races of Oceania and America have been suddenly brought into contact with the civilization which has been, in Europe, the slow growth of thousands of years. Food and climate have not changed, but a new element has been introduced into their environment. The New-Zealanders are very infertile, and nearly all the children are boys, and the census of 1872 for the Sandwich Islands gave a ration of 125 male births to 100 female births.

I believe that we may see, in these instances, the last effort of Nature to save the race from extinction, by securing a favorable variation.

It is no more than right, however, to point out that Düring himself gives a different explanation, and attributes the excess of male births under unfavorable conditions to the need for preventing close interbreeding. He shows that close interbreeding causes sterility, small size, and lack of general vigor and vitality; and he also shows that these effects are most marked when the other conditions of life are unfavorable, and that no evil effect follows close interbreeding when food is very abundant and the environment in general conducive to prosperity. As the evil effects of interbreeding are most marked when the environment is unfavorable, and as male births are then in excess, he believes that the excessive production of males is an adaptation, which has been gradually acquired for the purpose of preventing close interbreeding at the time when it is injurious.

I believe that a little examination will show that this explanation is imperfect, although true in a certain sense. As natural selection can not act in such a way as to establish an injurious property, the evil effects of interbreeding can not be primary. The thing which is advantageous and which has been secured by natural selection is crossing, or the sexual union of organisms which are not closely related.

As the object of crossing is to secure variability, it is most necessary when variation is needed, that is, when the conditions of life are unfavorable.

Natural selection has accordingly acted to secure this, by rendering the offspring of a cross more able to resist an unfavorable change in the conditions of life than the offspring of closely related parents or the parthenogenetic children of unfertilized females, and the excessive birth of males, under unfavorable conditions, is for the purpose of securing variation, rather than the prevention of interbreeding.

In conclusion, I wish to again call the attention of the reader to Düring's papers, as they are filled with interesting reflections and suggestive observations which have received no notice in this short review.

They not only contain a treasury of facts, but they also show that in many parts of the field there is a great lack of recorded observations, and as some of our readers may be able to contribute something toward filling these gaps, and thus to extend our knowledge of the subject, the writer of this review takes this occasion to ask all who have made any observations upon the number of male and female births of wild or domesticated animals to make their results known. If they are sent to him, he will take pleasure in tabulating them, and will give proper credit for them.

## MY SCHOOLS AND SCHOOLMASTERS.*

By Professor TYNDALL.

OUR lives are interwoven here below, frequently, indeed most frequently, without our knowing it. We are in great part molded by unconscious interaction. Thus, without intending it, the present representative of the Birkbeck family in Yorkshire has helped to shape my life. In 1856, or thereabout, Mr. John Birkbeck aided in founding on the slope of a Swiss mountain the Æggischhorn Hotel. The success of this experiment provoked in the neighboring commune a spirit of rivalry and imitation, and accordingly upon a bold bluff overlooking the Great Aletsch glacier was subsequently planted the Bel Alp Hotel. To the Bel Alp I went in my wanderings. Seeing it often, I liked it well, until at length the thought dawned upon me of building a permanent nest there. Before doing so, however, I imitated the birds, chose and was chosen by a mate who, like myself, loved the freedom of the mountains, and we built our nest together. From that nest I have come straight to the Birkbeck Institution, so that the following chain of connection stretches between Mr. John Birkbeck and me: Without him there would have been no Æggischhorn; without the Æggischhorn there would have been no Bel Alp; without Bel Alp there would have been no Tyndall's nest, and without that nest the person who now

* An address delivered at the Birkbeck Institution, Wednesday, October 22, 1884.

addresses you would undoubtedly be a different man from what he is. His bone would have been different bone; his flesh different flesh—nay, the very gray matter of his brain, which is said to be concerned in the production of thought, would have been different from what it now is. I wrote to Mr. Norris from the Alps asking him to choose between a purely scientific lecture and an address based on the experiences of my own life. He chose the latter. I do not, however, ask you to blame Mr. Norris, but to blame me, if a chapter from the personal history of a worker, instead of proving a stimulus and an aid, should seem to you flat, stale, and unprofitable. . . . Speaking of the opportune beneficence of Dr. Birkbeck's movement reminds me that, in the days of my youth, personally and directly, I derived profit from that movement. In 1842 and thereabout it was my privilege to be a member of the Preston Mechanics' Institution—to attend its lectures and make use of its library. One experiment made in these lectures I have never forgotten—Surgeon Corless, I think it was, who lectured on respiration, explaining, among other things, the changes produced by the passage of air through the lungs. What went in as free oxygen came out bound up in carbonic acid. To prove this he took a flask of lime-water, and, by means of a glass tube dipped into it, forced his breath through the water. The carbonic acid from the lungs seized upon the dissolved lime, converting it into carbonate of lime, which, being practically insoluble, was precipitated. All this was predicted beforehand by the lecturer, but the delight with which I saw his prediction fulfilled, by the conversion of the limpid lime-water into a turbid mixture of chalk and water, remains with me, as a memory, to the present hour. The students of the Birkbeck Institution may therefore grant me the honor of ranking myself among them as a fellow-student of a former generation. At the invitation of an officer of the Royal Engineers, who afterward became one of my most esteemed and intimate friends, I quitted school in 1839 to join a division of the Ordinance Survey. The profession of a civil engineer having then great attractions for me, I joined the survey, intending, if possible, to make myself master of all its operations, as a first step toward becoming a civil engineer. Draughtsmen were the best paid, and I became a draughtsman. But I habitually made incursions into the domains of the calculator and computer, and thus learned all their art. In due time the desire to make myself master of field operations caused me to apply for permission to go to the field. The permission was granted by my excellent friend General George Wynne, who then, as Lieutenant Wynne, observed and did all he could to promote my desire for improvement. Before returning to the office I had mastered all the mysteries of ordinary field-work, and by a fortunate opportunity, and with the sound knowledge of elementary geometry and trigonometry which I had acquired before leaving school, was enabled successfully to make some trigonometrical observations, though there had been bets against me. The pay upon the Ordinance Survey

was very small, but, having ulterior objects in view, I considered the instruction received as some set-off to the smallness of the pay. It might prevent some of you young Birkbeckians from considering your fate specially hard, or from being daunted, because from a very low level you have to climb a very steep hill, when I tell you that, on quitting the Ordinance Survey in 1843, my salary was a little under twenty shillings a week. I have often wondered since at the amount of genuine happiness which a young fellow, of regular habits, not caring for either pipe or mug, may extract even from pay like that. Then came a pause, and after it the mad time of the railway mania, when I was able to turn to account the knowledge I had gained upon the Ordinance Survey. In Staffordshire, Cheshire, Lancashire, Durham, and Yorkshire, more especially in the last, I was in the thick of the fray. It was a time of terrible toil. The day's work in the field usually began and ended with the day's light, while frequently in the office, and more especially as the awful 30th of November—the latest date at which plans and sections of projected lines could be deposited at the Board of Trade—drew near, there was little difference between day and night, every hour of the twenty-four being absorbed in the work of preparation. Strong men were broken down by the strain and labor of that arduous time. Many pushed through, and are still among us in robust vigor; but some collapsed, while others retired with large fortunes, but with intellects so shattered that, instead of taking their places in the front rank of English statesmen, as their abilities entitled them to do, they sought rest for their brains in the quiet lives of country gentlemen. In my own modest sphere I well remember the refreshment I occasionally derived from five minutes' sleep on a deal table, with "Babbage and Callet's Logarithms" under my head for a pillow. On a certain day, under grave penalties, certain levels had to be finished, and this particular day was one of agony to me. The atmosphere seemed filled with mocking demons, laughing at the vanity of my efforts to get the work done. My leveling staves were snapped, and my theodolite was overthrown by the storm. When things are at their worst a kind of anger often takes the place of fear. It was so in the present instance: I pushed doggedly on, and just at nightfall, when barely able to read the figures on my leveling-staff, I planted my last "bench-mark" on a tombstone in Haworth churchyard. Close at hand was the vicarage of Mr. Brontë, where the genius was nursed which soon afterward burst forth and astonished the world. It was a time of mad unrest—of downright monomania. In private residences and public halls, in London reception-rooms, in hotels and the stables of hotels, among gypsies and costermongers, nothing was spoken of but the state of the share-market, the prospects of projected lines, the good fortune of the ostler or pot-boy who by a lucky stroke of business had cleared ten thousand pounds. High and low, rich and poor, joined in the reckless game. During my professional connection with

railways I endured three weeks' misery. It was not defeated ambition; it was not a rejected suit; it was not the hardship endured in either office or field; but it was the possession of certain shares purchased in one of the lines then afloat. The share list of the day proved the winding-sheet of my peace of mind. I was haunted by the Stock Exchange. I became at last so savage with myself that I went to my brokers and put away, without gain or loss, the shares as an accursed thing. When railway work slackened I accepted, in 1847, a post as a master in Queenwood College, Hampshire—an establishment which is still conducted with success by a worthy principal. There I had the pleasure of meeting Dr. Franklin, who had charge of the chemical laboratory. Queenwood College had been the Harmony Hall of the Socialists, which, under the auspices of the philanthropist Robert Owen, was built to inaugurate the millennium. The letters "C of M," Commencement of Millennium, were actually inserted in flint in the brick-work of the house. Schemes like Harmony Hall look admirable upon paper; but, inasmuch as they are formed with reference to an ideal humanity, they go to pieces when brought into collision with the real one. At Queenwood, I learned, by practical experience, that two factors went to the formation of a teacher. In regard to knowledge he must, of course, be master of his work. But knowledge is not all. There may be knowledge without power—the ability to inform, without the ability to stimulate. Both go together in the true teacher. A power of character must underlie and enforce the work of the intellect. There are men who can so rouse and energize their pupils—so call forth their strength and the pleasure of its exercise—as to make the hardest work agreeable. Without this power it is questionable whether the teacher can ever really enjoy his vocation—with it I do not know a higher, nobler, more blessed calling than that of the man who, scorning the "cramming" so prevalent in our day, converts the knowledge he imparts into a lever, to lift, exercise, and strengthen the growing minds committed to his care. At the time here referred to I had emerged from some years of hard labor the fortunate possessor of two or three hundred pounds. By selling my services in the dearest market during the railway madness the sum might, without dishonor, have been made a larger one; but I respected ties which existed prior to the time when offers became lavish and temptation strong. I did not put my money in a napkin, but cherished the design of spending it in study at a German university. I had heard of German science, while Carlyle's references to German philosophy and literature caused me to regard them as a kind of revelation from the gods. Accordingly, in the autumn of 1848, Frankland and I started for the land of universities, as Germany is often called. They are sown broadcast over the country, and can justly claim to be the source of an important portion of Germany's present greatness. A portion, but not all. The thews and sinews of German men were not given by German universities. The

steady fortitude and valiant laboriousness which have fought against, and triumphed over, the gravest natural disadvantages, are not the result of university culture. But the strength and endurance which belong to the German, as a gift of race, needed enlightenment to direct it; and this was given by the universities. Into these establishments was poured that sturdy power which in other fields had made the wastes of Nature fruitful, and the strong and earnest character had thus superimposed upon it the informed and disciplined mind. It is the coalescence of these two factors that has made Germany great; it is the combination of these elements which must prevent England from becoming small. We bless God for our able journalists, our orderly Parliament, and our free press; but we bless him still more for "the hardy English root" from which these good things have sprung. We need muscle as well as brains—character and resolution as well as expertness of intellect. Lacking the former, though possessing the latter, we have the bright foam of the wave without its rock-shaking momentum. Our place of study was the town of Marburg, in Hesse-Cassel, and a very picturesque town Marburg is. It clambers pleasantly up the hill-sides, and falls as pleasantly toward the Lahn. On a May day, when the orchards are in blossom, and the chestnuts clothed with their heavy foliage, Marburg is truly lovely. My study was warmed by a large stove. At first I missed the gleam and sparkle from flame and ember, but I soon became accustomed to the obscure heat. At six in the morning a small milch-brod and a cup of tea were brought to me. The dinner-hour was one, and for the first year or so I dined at an hotel. In those days living was cheap in Marburg. Dinner consisted of several courses, roast and boiled, and finished up with sweets and dessert. The cost was a pound a month, or about eightpence per dinner. I usually limited myself to one course, using even that in moderation, being already convinced that eating too much was quite as sinful, and almost as ruinous, as drinking too much. By attending to such things I was able to work without weariness for sixteen hours a day. My going to Germany had been opposed by some of my friends as Quixotic, and my life there might, perhaps, be not unfairly thus described. I did not work for money; I was not even spurred by "the last infirmity of noble minds." I had been reading Fichte, and Emerson, and Carlyle, and had been infected by the spirit of these great men. Let no one persuade you that they were not great men. The Alpha and Omega of their teaching was loyalty to duty. Higher knowledge and greater strength were within reach of the man who unflinchingly enacted his best insight. It was a noble doctrine, though it might sometimes have inspired exhausting disciplines and unrealizable hopes. At all events, it held me to my work, and, in the long cold mornings of the German winter, defended by a Schlafrock lined with catskin, I usually felt a freshness and strength—a joy in mere living and working, derived from perfect

health—which was something different from the malady of self-righteousness. I concentrated my chief attention upon mathematics, physics, and chemistry. To the illustrious chemist Bunsen I am specially indebted. He was a man of fine presence, tall, handsome, courteous, and without a trace of affectation or pedantry. He merged himself in his subject; his exposition was lucid, and his language pure; he spoke with the clear Hanoverian accent which is so pleasant to English ears. He was every inch a gentleman. After some experience of my own, I still look back on Bunsen as the nearest approach to my ideal of a university teacher. Professor Stegmann gave me the subject of my dissertation when I took my degree. Its title in English was, "On a Screw Surface with Inclined Generatrix, and on the Conditions of Equilibrium on such Surfaces." I resolved that if I could not, without the slightest aid, accomplish the work from beginning to end, it should not be accomplished at all. Wandering among the pine-woods, and pondering the subject, I became more and more master of it; and when my dissertation was handed in to the Philosophical Faculty it did not contain a thought that was not my own. Continuing to work strenuously but happily till the autumn of 1850, I then came to England. But I soon returned to Germany. To those Marburg days I look back with warm affection, both in regard to nature and to man. To Berlin I went in the beginning of 1851. Magnus, Dove, Mitscherlich, Heinrich and Gustav Rose, Ehrenberg, Riess, Du Bois-Reymond, and Clausius were the scientific stars of the university at that time. From all these eminent men I received every mark of kindness, and formed with some of them enduring friendships. Helmholtz was at this time in Königsberg. He had written his renowned essay on the "Conservation of Energy." In his own house I had the honor of an interview with Humboldt. He rallied me on having contracted the habit of smoking in Germany, his knowledge on this head being derived from my little paper on a water-jet, where the noise produced by the rupture of a film between the wet lips of a smoker is referred to. He gave me various messages to Faraday, declaring his belief that he (Faraday) had referred the annual and diurnal variation of the declination of the magnetic needle to their true cause—the variation of the magnetic condition of the oxygen of the atmosphere. I was interested to learn from Humboldt himself that, though so large a portion of his life had been spent in France, he never published a French essay without having it first revised by a Frenchman. In those days I not unfrequently found it necessary to subject myself to a process which I called depolarization. My brain, intent on its subjects, used to acquire a set, resembling the rigid polarity of a steel magnet. It lost the pliancy needful for free conversation, and to recover this I used to walk occasionally to Charlottenburg or elsewhere. From my experiences at that time I derived the notion that hard thinking and fleet talking do not run together.

Far from seeing in this address a display of egotism, you will, I believe, accept it as a fragment of the life of a brother who has felt the scars of the battle in which many of you are now engaged. Duty has been mentioned as my motive force. In Germany one heard this word much more frequently than the word glory. The philosophers of Germany were men of the loftiest moral tone. In fact, they were preachers of religion as much as expounders of philosophy. It would to a certain extent be true to say that from them the land takes its moral color; but it should be added that the German philosophers were themselves products of the German soil, probably deriving the basis of their moral qualities from a period anterior to their philosophy. I asked two Prussian officers whom I met in the summer of 1871, at Pontresina, how the German troops behaved when going into battle—did they cheer and encourage each other? The reply I received was: "Never in our experience has the cry, 'Wir müssen siegen'—we must conquer—been heard from German soldiers; but in a hundred instances we have heard them resolutely exclaim, 'Wir müssen unser Pflicht thun'—we must do our duty." It was a sense of duty rather than love of glory that strengthened those men and filled them with an invincible heroism. We in England have always liked the iron ring of the word "duty." It was Nelson's talisman at Trafalgar. It was the guiding star of Wellington. When in his days of freshness and of freedom our laureate wrote his immortal ode on the death of the Duke of Wellington, portions of which both he and others might well take to heart at the present moment, he poured into the praise of duty the full strength of his English brain:

"Not once or twice in our rough island story
The path of duty was the way to glory:
He that walks it, only thirsting
For the right, and learns to deaden
Love of self, before his journey closes
He shall find the stubborn thistle bursting
Into glossy purples which outredden
All voluptuous garden roses."

—*Pall Mall Budget.*

## GLADIATORS OF THE SEA.*

By FREDERIK A. FERNALD.

IN the ancient city of Siena, secluded among the hills of Northern Italy, Christopher Columbus received his education, and there, over the portal of the old collegiate church, hangs a memento of his

* This article is largely made up from "Materials for a History of the Sword-fishes," by G. Brown Goode, in the "United States Fish Commission Report for 1880," from which the cuts have also been obtained.

earliest voyage across the Atlantic. It consists of the arms and armor worn by the discoverer when he first set foot upon land in the New World, and the weapon of a native killed by his men before they reached the shore — the sword of a sword-fish. The names of this fish in he principal languages of Europe are simply variations of the *Gladius* of ancient Italy, and *Xiphias*, the name by which Aristotle, the father of zoology, called the same fish twenty-three hundred years ago. At the very inception of binomial nomenclature Linnæus called it *Xiphias gladius*, by which name it has been known to science ever since. The form of the sword-fish may be seen in Fig. 1. It is without scales. Its color is a rich purplish blue above, shading into silvery white beneath; the lower side of the beak is brownish purple. A sword-fish which does not exceed the average weight of a man is a small fish; the average weight is about three hundred and fifty pounds, and doubtless many attain the weight of five hundred pounds, but fish weighing above six hundred are exceptional. Newspapers are fond of recording the occurrence of giant fish, weighing fifteen hundred pounds and upward,

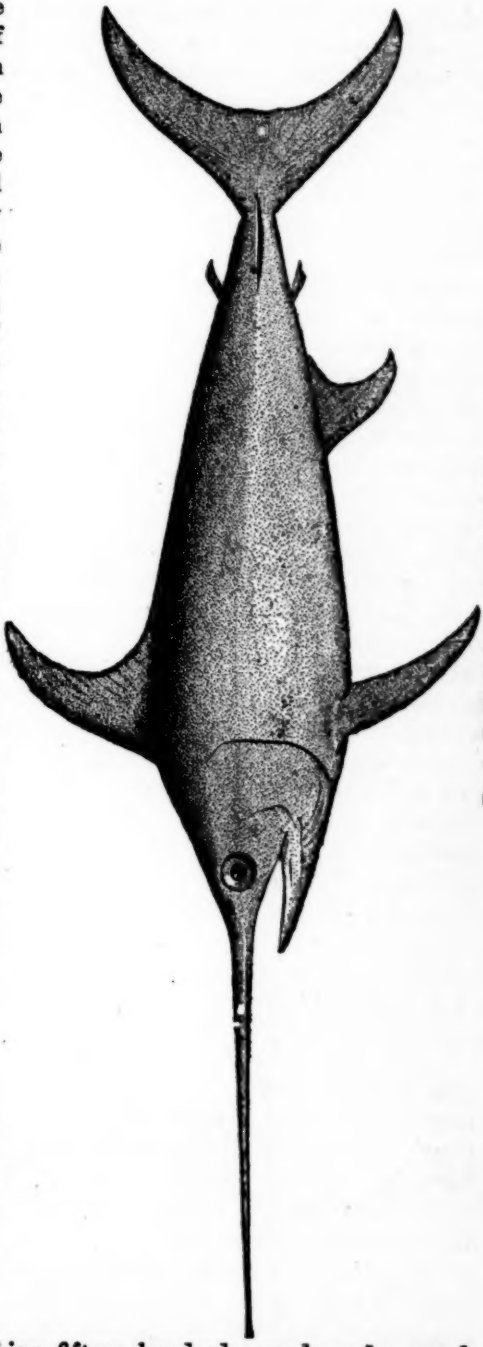

FIG. 1.—THE SWORD-FISH (*Xiphias gladius*).

and old sailors will in good faith describe the enormous fish which they saw at sea but could not capture; one well-authenticated instance of accurate weighing, however, is much more valuable. The average extreme length seems to be eleven feet, of which the sword is nearly four feet. A fish has been taken by Captain Benjamin Ashby, a New England sword-fisherman, whose sword measured almost six feet. The fish when salted weighed six hundred and thirty-nine pounds, so that its live weight must have been as much as seven hundred and fifty pounds.

The sword-fish ranges along the Atlantic coast of America from Jamaica to Nova Scotia; it is abundant on the shores of Western Europe, entering the Baltic and Mediterranean Seas, and is found also on the west coast of Africa, about New Zealand, and along the Pacific coast of America from Peru to California. On the coasts of Maine, Massachusetts, and Rhode Island they abound in the summer months; their occurrence off New York is not unusual, but in our Southern waters they do not appear to remain.

A sword-fish when swimming near the surface usually allows its dorsal fin and the upper lobe of its caudal fin to stand out of the water several inches. It is this habit which enables the fisherman to detect the presence of the fish. It commonly swims so slowly that a fishing-smack with a light breeze has no difficulty in overtaking it, but when excited its motions are very rapid and violent. Many curious instances are on record of attacks by this fish upon ships. Ælian, who wrote a little later than 200 A. D., says that the sword-fish has a sharp-pointed snout with which it is able to pierce the sides of a ship and send it to the bottom. He describes the sword as like the beak of the ship known as the trireme, which was rowed with three banks of oars. In 1871 the little yacht Redhot, of New Bedford, was out sword-fishing, and a sword-fish had been hauled in to be lanced, when it attacked the vessel and pierced her side so as to sink her. The London "Daily News" of December 11, 1868, contained the following paragraph, probably from the pen of Professor R. A. Proctor: "Last Wednesday the Court of Common Pleas—rather a strange place, by-the-by, for inquiring into the natural history of fishes—was engaged for several hours in trying to determine under what circumstances a sword-fish might be able to escape scot-free after thrusting his snout into the side of a ship. The gallant ship Dreadnaught, thoroughly repaired and classed A 1 at Lloyd's, had been insured for three thousand pounds against all the risks of the seas. She sailed March 10, 1864, from Colombo for London. Three days later the crew while fishing hooked a sword-fish. Xiphias, however, broke the line, and a few moments after leaped half out of the water, with the object, it should seem, of taking a look at his persecutor, the Dreadnaught. Probably he satisfied himself that the enemy was some abnormally large cetacean, which it was his natural duty to attack forth-

with. Be this as it may, the attack was made, and at four o'clock the next morning the captain was awakened with the unwelcome intelligence that the ship had sprung a leak. She was taken back to Colombo, and thence to Cochin, where she was hove down. Near the keel was found a round hole, an inch in diameter, running completely through the copper sheathing and planking. As attacks by sword-fish are included among sea-risks, the insurance company was willing to pay the damages claimed by the owners of the ship if only it could be proved that the hole had really been made by a sword-fish. No instance had ever been recorded in which a sword-fish had been able to withdraw his sword after attacking a ship. A defense was founded on the possibility that the hole had been made in some other way. Professor Owen and Mr. Frank Buckland gave their evidence, but neither of them could state quite positively whether a sword-fish which had passed its beak through three inches of stout planking could withdraw without the loss of its sword. Mr. Buckland said that fish have no power of backing, and expressed his belief that he could hold a sword-fish by the beak; but then he admitted that the fish had considerable lateral power, and might so 'wriggle its sword out of a hole.' And so the insurance company will have to pay nearly six hundred pounds because an ill-tempered fish objected to be hooked, and took its revenge by running full tilt against copper sheathing and oak planking."

The instrument with which such damage is done is a flat, bony prolongation of the upper jaw, which tapers slightly to a nearly square end. Fig. 2, although representing the weapon of a very young fish, will serve to show the appearance of the upper and under sides of the sword. Its material is not very hard, and it would fail to pierce a ship's timbers but for the enormous swiftness with which it is driven by the charging fish.

An unsigned article in "Harper's Weekly" for October 25, 1879, contains a mention of a sword being found, in 1725, imbedded as deeply in the side of the British ship Leopard as an iron bolt of the same size could be driven by nine strokes of a twenty-five-pound hammer. Yet the fish drove it in at a single thrust. The same writer tells the following still more remarkable story: "On the return of the whale-ship Fortune to Plymouth, Massachusetts, in 1827, the stump of a sword-blade of this fish was noticed projecting like a cog outside, which, on being traced, had been driven through the copper sheathing, an inch board under-sheathing, a three-inch plank of hard wood, the solid white-oak timber twelve inches thick, then through another two-and-a-half-inch hard oak ceiling, and lastly penetrated the head of an oil-cask, where it stuck, not a drop of the oil having escaped."

One of the traditions of the sea, time-honored, believed by all mariners, handed down in varied phases in a hundred books of ocean-travel, relates to the terrific combats between the whale and the sword-

fish aided by the thresher-shark. The fierce gladiator was said to attack from below, goading his mighty adversary to the surface with his terrible weapon, while the thresher, at the top of the water, belabored him with his long, lithe tail. Skeptical modern science is not satisfied with this interpretation of any combat at sea seen at a distance. It recognizes the improbability of aggressive partnership between two creatures so different as the sword-fish and a shark, and explains the turbulent encounters occasionally seen at sea by ascribing them to the attacks of the killer-whale upon larger species of the same order.

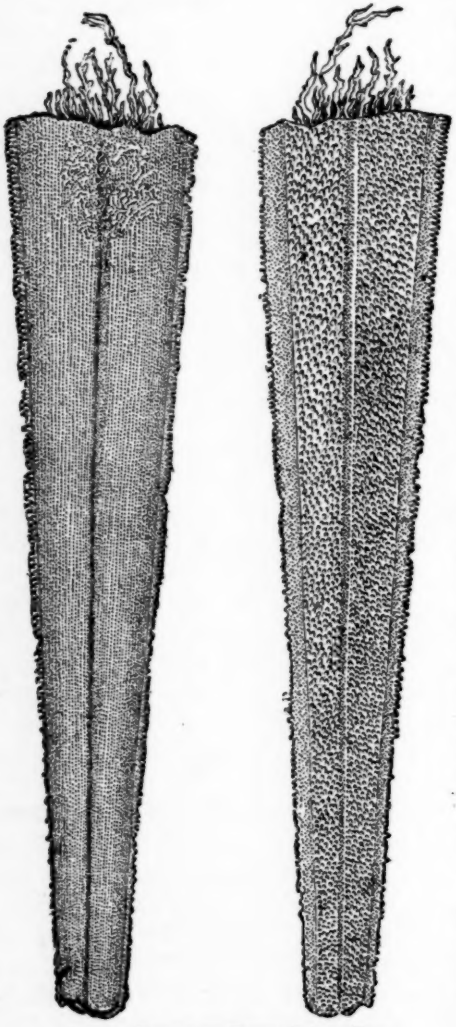

FIG. 2.—SWORD OF YOUNG SWORD-FISH.

Such a large animal as the sword-fish can have but few formidable antagonists. The tunny, or horse-mackerel, other sword-fishes, and sharks, are its only peers in size, and of these the sharks are probably its worst foes. Mr. John A. Thomson, of New Bedford, states that the bill-fish is an inveterate enemy. Bill-fish appear about the last of the season, and the sword-fish are sure to leave soon after. Many species of parasites are found upon the sword-fish; some hang on the gills, others fasten themselves to different parts of the alimentary canal, and others still bore into the flesh. They may be divided into two groups, worm-like parasites and crustacean parasites, the latter resembling small crabs and lobsters. Several species, as might be expected from the size of the fish, are among the giants of their races. There is also a species of remora or sucker which is often found attached to the gill-cover of the sword-fish, and to no other fish. It is, however, to be regarded as a messmate rather than as a true parasite.

Although sword-fish are so plentiful in American waters, they are never seen of less than three feet in extreme length. Old fishermen who have taken and dressed them by the hundreds state that they have never found any traces of spawn in them. The absence of young fish and spawning females would indicate that they do not breed on our coast. In the Mediterranean the young are so plentiful as to be a common article of food. The appearance of the young fish when about an inch and a half long is shown in Fig. 3.

Menhaden, mackerel, bonitoes, blue-fish, and other species which swim in close schools, are the usual food of the sword-fish. A school of small fish has been seen crowded together near the surface, when their enemy appeared rising through the dense mass, and half out of water, and literally fell upon them with the sword and slew them in large numbers. Menhaden have been found floating which have been cut nearly in two by a blow of the sword. It is in pursuit of these fish that the sword-fish come to our Northern Atlantic shores in the summer months. The sword-fishery season opens in the neighborhood of Sandy Hook about the first of June; the fish are very abundant about Block Island and Nantucket in July and August, disappearing with the first cold weather in October. They are, like mackerel, at first very poor and lean, but as the season advances they grow fatter. For many years from three to six thousand have been taken annually on the New England coast, and there are no signs of any decrease or increase in their numbers. It is not unusual for twenty-five or more to be seen in the course of a single day's cruising, and sometimes as many as this are in sight from the mast-head at one time. One Gloucester schooner, the Midnight, Captain Alfred Wixon, took fourteen in one day, in 1877, on George's Banks.

The apparatus ordinarily employed for the capture of the sword-fish is a harpoon with a detachable head. The pole is of hard wood, fifteen or sixteen feet in length, and from an inch and a half to two inches in diameter. To this is fastened an iron rod or shank, about two feet long and five eighths of an inch in diameter, and having a deep socket into which the pole sets. Upon the end of the shank fits somewhat securely the head of the harpoon, known to the fishermen by the names "sword-fish iron," "lily-iron," and "Indian dart." The lily-iron consists of a two-pointed piece of metal, having a socket running lengthwise on one side at the middle. In this is inserted the end of the harpoon-shank, and to it or near it is attached also the harpoon-line. When the iron has been plunged point first into the body of the fish, it is released by the withdrawal of the pole from the socket, and, by the pull of the line attached at its middle, is at once turned crosswise to the opening through which it entered, and is thus prevented from withdrawal.

The fish are always harpooned from the end of the bowsprit of a sailing-vessel. All vessels regularly engaged in this fishery are sup-

FIG. 3.—YOUNG OF SWORD-FISH.

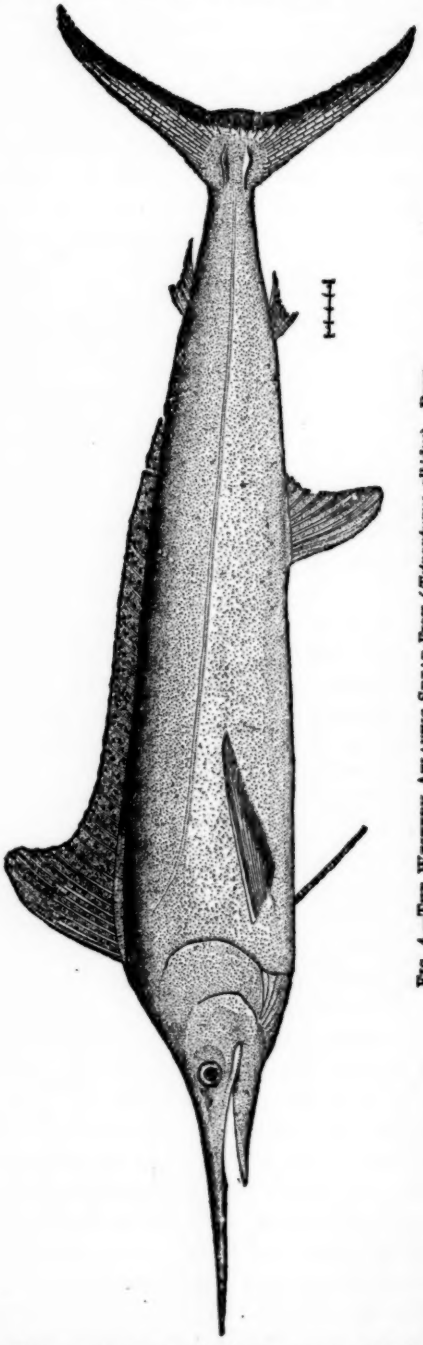

FIG. 4.—THE WESTERN ATLANTIC SPEAR-FISH (*Tetropturus albidus*). Poey.

plied with an apparatus for the support of the harpooner, which consists of a wooden platform about two feet square, upon which the

harpooner stands, and an upright bar of iron three feet high, rising from the tip of the bowsprit just in front of this platform. At the top of this bar is a bow of iron in a nearly circular form, to surround the waist of the harpooner. This structure is called the "rest" or the "pulpit." A man is always stationed at the mast-head, whence, with the keen eye which practice has given him, he can easily descry the tell-tale dorsal fins at a distance of two or three miles. When a fish has been sighted, the watch "sings out," and the vessel is steered directly toward it. The skipper takes his place in the pulpit, holding the harpoon with both hands by the upper end, and directing the man at the wheel by voice and gesture how to steer. When the fish is from six to ten feet in front of the vessel, it is struck. The harpoon is not thrown; the strong arm of the harpooner punches the dart into the back of the fish beside the dorsal fin, and the pole is withdrawn. The line is from fifty to one hundred and fifty fathoms long, and the end is either made fast on board the smack, or attached to a keg or some other form of buoy and thrown overboard. After the fish has exhausted himself by dragging the buoy through the water, it is picked up, the fish is hauled alongside, and killed with a lance. In the mean time, several other fish may have been struck and left to tire themselves out in the same way. The following interesting account of the taking of a sword-fish is from an article by Mr. C. F. Holder, published several years ago in "Forest and Stream": "The man waited until we were almost upon them, and as one of them turned, as if in idle curiosity, to see what the great shadow meant, he hurled a spear, and the next moment the huge fish sprang from the water and, with a furious twist, tried to shake out the iron. So great was the effort that it fell on its side with a crash, and for a moment was still, but it was only for a second. The line jumped into activity, and rushed out so you could not follow it, now swaying to and fro and making the water fly like rain. About fifty feet of line had gone out, when six of us managed to get a fair hold on the line, and attempted to try our strength. If six individuals were ever jerked around in a more vivacious manner, they have my utmost sympathies. Now the sword-fish would land us all together in a heap, then slacken up, and take us unawares, throwing us to the deck with a force that fully came up to my preconceived ideas of the sport. He would undoubtedly have dragged us all overboard if the rope had not been sure and fast. This sort of fun was kept up for about fifteen minutes, when the fish perceptibly weakened, and the long rushes to the right and left grew feebler and feebler, until we ventured to haul in. At last we had the brute alongside. A rope was rigged from the peak and fastened around the long sword, and the monster was rolled on board the sloop. We measured our game, which was nine feet six inches long. Though I have frequently caught sharks which measured thirteen feet, I never saw any that showed near the strength of this peculiar

creature." This marine gladiator is not always content to seek only to escape. He knows the capabilities of the weapon which he wields, and sometimes proves a powerful antagonist, sending his pursuers' vessel into harbor almost sinking from injuries which he has inflicted. The fishermen, too, occasionally receive injuries from his sword. One of Captain Ashby's crew was severely wounded by a sword-fish which thrust its beak through the bottom of a boat in which the man was standing, and penetrated two inches into his naked heel. One or two instances are on record of the capture of sword-fish upon an ordinary hand-line, and it is probable that this is much more common than has been usually supposed. Within the past few years it has not been unusual for sword-fish to become entangled in the long lines of halibut-fishermen on the northern banks. This manner of taking them is, of course, purely accidental, and is rather vexatious than otherwise to the fishermen.

The bulk of the yearly catch is sold fresh. Most of the fish are taken into New Bedford, and some are carried to New London. Until quite recently nearly all were disposed of in that vicinity. About 1864 a few were sent to Boston as an experiment, and the demand for sword-fish in that market has since rapidly increased. It is not well known in New York. When the first fish reaches New Bedford, it is eagerly sought at twenty cents a pound retail. In 1873 within forty-eight hours after the arrival of the first one, fifty-two were brought in, bringing the retail price down to eight and ten cents, for which the fish clear of bone is usually retailed throughout the season. The wholesale price for "clean fish" is about twelve cents for the first catch, falling rapidly to two or three cents. The fish is of a gray color, its texture is coarse, somewhat resembling halibut, and though a trifle oily is a very acceptable article of food. Its flavor is by many considered fine, and is not unlike that of the blue-fish. Sword-fish are usually cut up into steaks, thick slices across the body, which may be broiled or boiled.

In Fig. 4 is shown another member of the sword-fish family, the bill-fish or spear-fish. It occurs on our Atlantic coast from the West Indies to Southern New England, and in nearly the same foreign waters in which its more celebrated relative is found. It resembles the sword-fish in movements and manner of feeding. About Mauritius they are taken in deep water with hook and line, or speared when near the surface. When hooked or speared they are said to make for the boats, taking tremendous leaps in the air, and if care is not taken they will jump into the boats, or pierce them with their bills, to the great consternation of the fishermen. The species attains a large size, one having been seen measuring twenty-six feet. The fish is highly esteemed in the Mauritius. Near the backbone it is of a salmon-color; lower down it is red and like coarse beef.

The sail-fish is a member of this family, and is especially notable

for its enormous dorsal fin. Its range may be said to be from 30° south to 40° north latitude. No observations have been made upon the sail-fish in this country. In the life of Sir Stamford Raffles there is the following account from Singapore, under date of November 30, 1822: "The only amusing discovery we have recently made is that of a sailing-fish, called by the natives *Ikan layer*, of about ten or twelve feet long, which hoists a mainsail, and often sails in the manner of a native boat, and with considerable swiftness. I have sent a set of the sails home, as they are beautifully cut, and form a model for a fast sailing-boat. When a school of these are under sail together they are frequently mistaken for a fleet of native boats." The appearance of this fish is shown in Fig. 5.

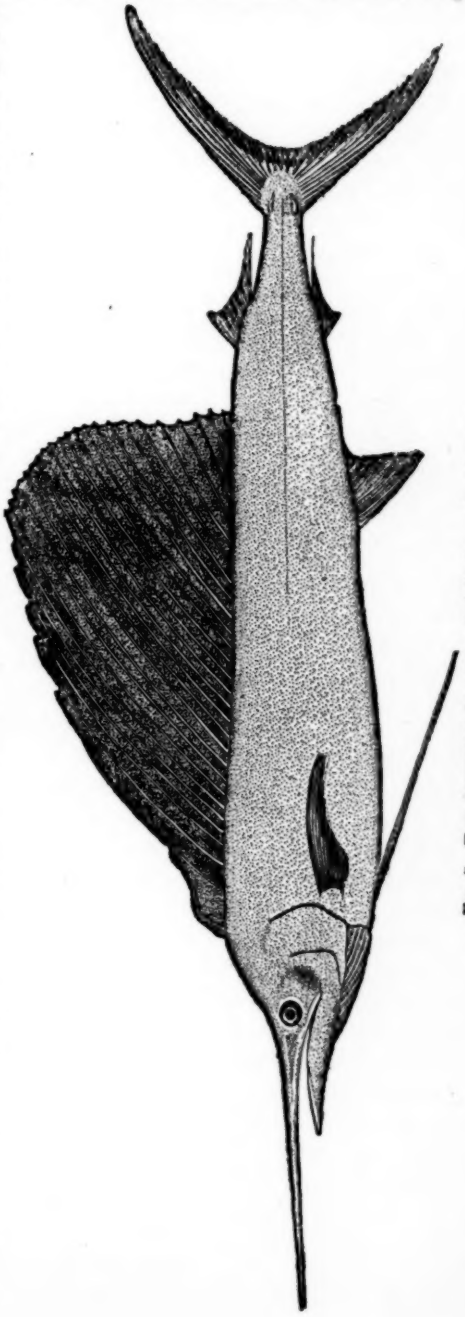

FIG. 5.—THE AMERICAN SAIL-FISH (*Histiophorus Americanus*).

A sketch of the gladiators of the sea would not be complete without some mention of the saw-fish and the narwhal. The saw-fish family is allied to the sharks, having a similar elongated and rounded body, and unequal tail-lobes. They are found in most warm seas and even near the poles; one species is met with all along the Atlantic coast of the United States. They are rapid swimmers. The mouth is

on the under side of the head, and is furnished with teeth which are adapted to crushing crustaceans and similar creatures upon which they feed, and not for tearing flesh. Behind the eyes they have two large blow-holes.

The common saw-fish reaches a length of twelve to fifteen feet, of which the saw is about one third. It carries a much uglier weapon than the sword-fish, for along the edges of its beak are set pointed conical teeth, two or three inches apart. The number of teeth on each side varies from twenty to thirty. The "saw" is not used by being drawn backward and forward: in killing small fishes for food, the saw-fish charges among them, striking to the right and left with the serrated edges of its beak, and generally succeeds in disabling a considerable number. When a whale is the creature attacked, this terrible weapon is plunged into the soft, blubber-covered body of the cetacean, the saw-fish avoiding by superior agility the strokes of the tortured animal's tail, any one of which would end the career of the daring gladiator. His weapon is often found deeply imbedded in the side of a ship, and even after the death of its original owner the beak may still inflict grievous wounds, for the Polynesians are fond of using it as a sword.

The narwhal belongs to the order of whales, and hence is not a fish. When full grown it reaches a length of about sixteen feet; it has the rounded body and horizontally flattened tail of the whales, but its head is small and rounded more like that of the seal. It inhabits the Arctic seas, and is a valuable game for the Greenlanders, as its flesh is much prized by them, and it yields a moderate quantity of very delicate oil. The color of its skin is gray, varied by darker streaks and patches, and shading from almost black above to white underneath. The curious horn to which the narwhal owes its fame is not a prolongation of the jaw as in the case of the fishes just described, but is a long tooth, like the tusks of the elephant or the boar. In the upper jaw of the young narwhal are found two small tusks, which in the female regularly remain undeveloped throughout her life. In the male the left tusk grows into a spirally grooved rod, sometimes attaining the length of ten feet. A large narwhal's tusk has no small commercial value, for the ivory is very hard and solid, will take a high polish, and keeps its beautiful whiteness a long time. Several ingenious speculations have been made in regard to the use of this remarkable growth; killing fish for food and breaking breathing-holes through the ice are two uses suggested which fail to account for the long tusk being confined to the males. The females certainly can not live on air alone, nor without air, and they can not count on always having a male near to wait upon them. It is more probably to be accounted for by the same reasons which explain the possession of horns, tusks, or mane by the males only of some land mammals. Rarely the right tusk is developed instead of the left, and sometimes the female has a weapon

like that of her mate. One female has been taken with both tusks developed, one being seven feet in length, the other five inches longer. Like his fellow-gladiators of the sea, the narwhal will occasionally thrust his gigantic foil into the side of a ship, where it usually breaks off, and, fitting the hole like a plug, seldom causes a leak. Narwhals are generally seen in herds of fifteen or twenty; they will come close about a ship, apparently from curiosity, and it is one of the most entertaining sights of the northern seas to watch them plunging about, spouting spray from their blow-holes, and clashing their long weapons together as if fencing.

## STUDYING IN GERMANY.

By HORACE M. KENNEDY.

THE tangible influence of Continental Europe, and especially of Germany, upon our thought and life, our education, habits, and morals, is perhaps greater than we are wont to grant or appreciate. This is in part due to the annual transfer of large sections of the German population to our shores and their absorption into our social system; but it is owing still more to the migration of Americans to Germany, where they come in contact with institutions that seem usually to impress them favorably. We often find ourselves speaking, with some chagrin at our own achievement, of German schools, of German purity in municipal government, of German stability and efficiency in the civil service, and of the self-respecting modesty of German boys and girls. Besides the hosts of tourists who jostle each other on the beaten courses of travel between the Rhine and Vienna, there is a steadily growing class of Americans who visit Germany to spend from one to five years in study. The American students at the great German universities now outnumber those from any non-German nation of Europe; and their number is greater than that of all other non-Continental states together. We may divide the American students in Germany into two classes: 1. Boys and girls sent or accompanied thither to get their preliminary education, and ranging in age from twelve to twenty years. These should be subdivided into—first, special students of music; and, second, students of such branches as are taught in our high-schools. 2. Young men, usually graduates of college, who wish to push their studies in special departments. Among the latter are often men who have already practiced their professions. The second class chiefly contains students of philology, medicine, and physics or chemistry. In any case this residence of several years in a foreign country acts profoundly upon the character of the student, and in ways quite outside of his book-knowledge.

First, let us consider those who go to prepare for college, or for a pro-

fession, or it may be, in the technical language of society, to "finish"; to study with private tutors, or in the gymnasium, or the *Realschule* (real-school). Though many of these students are girls, and many of the objections given also hold good in their case, we shall confine ourselves to boys. Of course, no careful parent would permit his daughter to reside in a foreign country, save under judicious chaperonage; no young girl should be personally subjected to the trials of making her own way among the officials and the managers of *pensions* in a German city. Some parents place their sons in Leipsic or Berlin, because they have observed that it is the thing to do; others, because they honestly think their children will profit by it—that is, more than they would at school, during the same time, at home. The fame of German schools and teachers may justify the latter view. In scope, purpose, and magnanimity, no schools surpass the German gymnasia and real-schools; and if we take the system throughout the nation and set it beside our school system as a whole, as applied in town and country and in various States, it is far superior, in all that education means, to it and to any other existing system. But, after a residence of over two years in German cities, and after some study of their secondary schools, I am convinced that our best high-schools and academies, public and private, are equal to the best German schools. The question, however, whether a boy at a German school would be better taught in his languages and mathematics, his sciences and his history, is not here pertinent. Grant for the moment that he is better taught; is he, by his German training, better fitted as a man to meet the questions of American life, and to succeed in his calling in America? At the age when his mind is most plastic, when those impressions are received that are to abide by him longest, he is transplanted to a society whose salient features are in reality startlingly unlike those amid which he is to make his way in life. I shall not attempt to decide whether these traits and ideas are preferable to our own; it is enough that they are different. Certain it is, for instance, that a boy in Germany is made unpractical; and that is a fatal quality in an American boy. He is filled with a love of research for its own sake, not for the sake of its bearing upon direct practical results. I should say that this is the chief quality which the boy is sure to get, and which will, in varying degrees, unfit him for the demands of his later work in any calling at home. He will be made impractical and speculative. The Germans are discoverers and recorders of facts, but they are poor at applying them. The boy also loses his sense of the value of time. Where all men, business and professional, move slowly, where it is the rule for the merchant, or the editor, to spend two hours at midday at his dinner and coffee, where "soon" means half a day, and "at once" an hour, the native boy does not suffer if he grows up in an atmosphere of deliberation. But this will not do in Broadway. Again, German boys are overworked. The American boy's school-life is easy com-

pared with the steady drill of the gymnasium and real-school, and he must compete with students who not only seem proof against poor ventilation and poor food, but are used to hard labor and short vacations, and he must do it in a foreign tongue. All gymnasium students must do work during the short summer vacation, requiring not less than one hour, and not more than two hours, daily. The course of the gymnasium lasts nine years. During the first seven years, there are ten hours per week of recitation in Latin, and, throughout the last seven years, six hours per week of Greek. The number of hours of recitation per week can not exceed thirty-two, and it can not be less than twenty-seven. There are no Saturday holidays, so that the time spent in recitation at school averages five hours a day. The law permits but ten weeks of vacation in the year: four weeks beginning on the third Saturday in July, two weeks at Christmas, two at Easter, one at Whitsuntide, and one at the end of the summer semester. The morning session begins at eight o'clock, and lasts until twelve, when there is a recess of one hour. Lessons are then continued until six o'clock. This is the plan every day, save Saturday and Wednesday, when the afternoon session is omitted. Compared with the work of an American high-school, this is stupendous, and it must tend to endanger the health of any pupil.

A symptom of overwork among German boys is short-sightedness and other diseases of the eye; this is so general that most travelers note it as a national characteristic. Not only do the majority of men who have studied wear glasses, but it is safe to say that a third of the school-boys wear them. This is said to be due to the intricacies of the German type; but poor ventilation, close application, and bad lighting can not fail also to weaken the eyes, and the American boy escapes none of the primitiveness of German home and school life.

Another loss which our typical boy suffers is in his Americanism. I am not fully prepared to say that in many respects this loss is not a gain, if you consider the boy as a sort of ideal abstraction; but, as regards his patriotism, his working power as a force in the community where he is to live, and his success in life, it is an actual loss. Imperceptibly he comes to regard the peasant, the servant, the hand-worker, as an inferior being. The sight of women helping dogs draw carts, or sawing wood in the streets, soon fails to shock him. In the larger sense he ceases to be a democrat; the grown man resists the forces which inevitably stamp the school-boy. And in the narrower sense, touching manners, personal habits, and speech, the boy is more markedly affected, and in ways which at home may lay him open to the charge of snobbery or pedantry. Although the rules of the gymnasium forbid beer-drinking and smoking, and teachers are responsible for the observance of these rules, the very atmosphere of a German town is so redolent of beer and smoke that the boy acquires a laxness regarding these habits which makes him out of place, and puts him at

a disadvantage, in a country where public opinion calls drinking a vice and where total abstinence is possible. He learns to shrug his shoulders in order to express the slightest doubt or innuendo, and he may easily learn to eat with his knife and make a noise at his soup. He will get methods of thought and points of view in themselves lofty, catholic, and public-spirited, which will, nevertheless, in his own country, as things are, retard rather than advance his career. The relations of school-boys, and even of men, with each other are so different from the intercourse of American students, that a boy may forget how to live comfortably with his fellows on his return. Again, a boy, well brought up and conscientious, when placed with liberal allowances of money in a German city, far from the restraints of home and associates, may get into ways that are unmistakably vicious and immoral. This is a danger that many parents discern when it is too late. The young man's position is perilous, especially when he is merely in the hands of private tutors, and lives in a *pension* or an hotel. I have myself known several boys who in two or three years in Leipsic and Berlin went from bad to worse—boys who at home in school or college would never have lost their footing. In German cities there is also a certain all-pervading tone of cynicism as regards religion, taken in the stricter sense. It is not fashionable, as with us, for the more intellectual people to go to church. Prussia is a Protestant nation; even Bismarck may be "evangelical" when occasion requires, and churches and preachers are not lacking. But the people whom the school-boy meets are usually agnostics or liberals—those who admire Luther as a man detest the raving atheism of the social-democrats, and are quite respectable. These are influences which few parents wish their boys to meet before they are matured.

Now, what is gained to offset these drawbacks and dangers? We will assume that the pupil could attend a good school at home, and that the expenditure of foreign travel and tuition would support him at such a school: the only real gain is a knowledge of German. He will certainly learn German. But on this point bears one fact which few appreciate. In his residence of from one to five years in Germany, speaking, reading, and writing little but German, the boy suffers a great loss in his English. This is the period when at home he is enriching his vocabulary and forming his style by English composition and the reading of English books. I would not undervalue the power one wields who has at command a great modern language, especially a language like the German, whose intrinsic beauty and force, and the wealth of whose literature, may go far to form the culture of any man. But, in making up a balance for the boy whose parents wish to have him trained abroad, this sacrifice of the mother-tongue must not be ignored.

These are some of the conditions suggested by the first class of students abroad. What is to be said as regards university students,

who are usually adults and specialists? In their case most of the foregoing objections do not hold; in fact, the situation is nearly reversed. We have no institutions which are the original fountains of scholarship, as are the German universities. The character, language, habits, of the men who study in them are in a measure formed. From observation I should say that the average age of Americans studying at the German universities is twenty-five. A graduate of one of our colleges or leading academies is ready to get and appreciate the best that the universities offer, as well as to observe and weigh the political and social elements in which he moves. His vacation travel is itself a delight and an education. The benefits of such study to men are so well understood that to point them out more in detail would be needless. But practical information as to the conditions of study, as to courses and degrees, is so vague, and in newspapers and magazines often so erroneous, that some facts may be given here. The graduate of any American college may matriculate, in full standing, at a German university on the presentation of his diploma and a passport. These take the place of the certificate of maturity (*Maturitätszeugniss*) from the gymnasium or real-school, which the German candidate must submit. Men who have no college diploma may attend lectures and have access to all privileges, but they may not become candidates for a degree. There is an impression that American students must encounter special difficulties in seeking a degree, and that few succeed in gaining it. This is an error. Many students do not *choose* to take the required subsidiary studies, lying perhaps outside of their special field, and hence do not try to get the degree. But it is a fact that fewer difficulties beset the American in this quest than the German himself. The university is the regular and essential avenue to the professions and many civil careers, and competition is very keen. But the faculties well know that the American does not seek promotion on German soil; they recognize the compliment of his long pilgrimage to their shrines, and they are willing to encourage him, avoiding the appearance of anything like a protective tariff. In the range of my acquaintance, as many as nine Americans have won the coveted title of Doctor of Philosophy, the degree now common to all departments; in some cases it has seemed that they met fewer difficulties than the German candidate, and in no case were the tests severer. The usual time necessary for this sort of graduation is six semesters, or three years. The student may spend each semester at a different university or all at the same one, if he chooses. And he may stand for a degree at any university he may select. The system is like that of a great society having many co-equal chapters. He must fix upon a special department of learning, and must follow two subordinate branches closely related to the main subject. During two or three years he "hears" lectures in the faculties dealing with his specialty. There are no examinations whatever before the final examination for the

degree, and no regular account is kept of attendance at lectures. He must give due notice of his intention to be a candidate, and must present a list of the lectures he has heard, the list certified by the signatures of the professors and of the quæstors; the latter officer vouches for the payment of all fees. But, most important of all, he must present a dissertation which shall be an original and thorough investigation in some portion, no matter how minute, of his general field of research. Though he is treated to a rigorous oral examination, this written work has the greater weight in forming the decision of the examiners.

But the degree is, after all, of little importance to the student; the question is, whether he would do well to study at the German university at all. In general, we may answer that the center of the world's scholarship is there, and, if a young man knows that he wants learning, there is the place to get it at its best. The allowances to be made for pedantry are not so grave as we are wont to imagine, and the fruits of ripe and patient investigation are offered, with a generous hand, in both lecture-room and pamphlet. There is, after all, no paradox in the conclusion that, while the boy may lose promptness, alertness, manners, fluency in English, and even health, the man gains, besides knowledge, incentives and standards that may make him a better citizen.

## STATE USURPATION OF PARENTAL FUNCTIONS.

By Sir AUBERON HERBERT.

(*Letter to the London "Times."*)

SIR: Your reviewer, reviewing Mr. Spencer's valuable book of "Man *vs.* The State" with great sympathy and interest, seems to wonder why Mr. Spencer does not believe in and admire the Factory Acts. Surely to protect children against parents greedy of gain is and must be a right act seems to be his instinctive thought, as it is that of so many other persons.

Will you let me point out one reason why these acts were and always will be, till they are swept away, a very mischievous, though a well-meant, stupidity? They simply are one among the many other stupid attempts to make an official regulation take the place of the unselfish care of parents for their children. How absurd the whole thing seems as one looks quietly back on what took place! Before any acts were passed, parents were supposed—and probably with justice enough in many cases—to be overworking their children, selling their bone and muscle for the wages they received. The acts are passed, and then the air is filled with congratulations on the immense progress made. Moloch shall not be worshiped any more; the white slavery is over; neither the manufacturer nor the parent shall draw an unholy

profit from the very life of the children. How hollow and untrue the whole thing was! As if there would have been a single worshiper of Moloch, whether he was parent or manufacturer, the less on the morrow; as if, by the mere idle method of holding some meetings, getting some votes together, and passing an act of Parliament, one fiber in the nature of the Moloch-worshipers would have undergone change! I say deliberately the idle method, because here is the root of the whole matter. All these official reforms are essentially idle. Is the nation to be sober? Pass an act of Parliament out of hand, and shut up the public-houses. Is it to be provident? Pass an act of Parliament and compel men to make provision for themselves. Is it to be intelligent? Pass an act of Parliament and harry the homes till every child is at school. Is it to consist of unselfish and devoted parents? Pass a factory act, and tie the hands of the parent so that he can no longer sell his child's labor. Nothing is required of us but to hold some enthusiastic meetings, make some speeches, write some letters to the "Times," and scrape votes enough together, and then all these great things shall be done. Happy world! How easily it is to be cured of its faults! We may now sink back contentedly into our arm-chairs for the rest of our life, enjoy the testimonials we received in the moment of enthusiasm, admire the statues that were gratefully raised to us, and reperuse our own speeches, as there remains nothing else for us to do in presence of the regeneration in human nature that our last batch of regulations has effected. In view of this modern plan of growing good in ten minutes, we disquieted ourselves very uselessly in past days about the amount of original sin in human nature and the ills and infirmities to which human flesh was heir. What fools men are not to enjoy perfect health, when Holloway's pills, Clarke's blood-mixture, and Eno's fruit-salts are to be had for the ordering; and what fools they are not to become sober, provident, intelligent, and unselfish, when all that is wanted is only to pass two or three acts of Parliament to provide them with the qualities wanted!

The word idle seems to me to suit the case with great nicety. Taking care of the people by acts of Parliament seems to me very like the care of the mother for her child who rings the bell at the Foundling Institution, places her child on the door-step, and then contentedly goes on her own way. Let us suppose that she is doing the best for her child, still the trouble on her part is short and soon over. The long, slow years of anxiety and labor that fall to other mothers will not be for her.

It all ended for her, fortunate woman, when she rang the institution-bell. In the same way the political philanthropist has learned to lay his burden with but short delay on other shoulders than his own. The world's troubles are but an easy nut to crack according to his creed. A new law, a new office in some public department, a new batch of officials, will cure all human perversities from the parent that

does not send his child to school down to the abandoned city sinner who outrages Mr. Dowsett's feelings by playing cards in the railway-carriage. Why should we tread any longer that toilsome road by which men have sought to better themselves and each other? Why paint a picture by hand, when you can do it so well by a chromo-lithographic process? Why exert ourselves to enlist the active moral forces of society on our side; to work by sympathy, discussion, advice and teaching of every kind; by personal contact; by that wonderful force of example which makes every better kind of life a magnetic power among the lower kinds; by that softening of character and greater gentleness that diffuse themselves everywhere, as savagery of all kinds is just allowed to melt quietly away under the thousand influences of civilization; by raising and ennobling our own motives for helping each other, and, above all, by constant efforts to enlarge and increase our own powers of seeing truly, so that we may understand what are the causes of the evils we see round us, and what are the conditions under which they can be successfully attacked? All this is simply superfluous in presence of the modern omniscient and omnipotent act of Parliament. Think how much trouble, how many long years of slow conversion are saved by our present admirable process of compulsion. Charlemagne—not St. Paul or St. John—was the really enlightened Christian apostle. Be baptized, or ——, is the one argument specially fitted for the souls of men. But, however excellent these compulsions may be for the first ten minutes, still every ten minutes has its afterward; and let me now ask, what is the after-fruit borne by these compulsions? Let us take for granted that before the first factory acts were passed many children were overworked. There were two ways open for those to take who felt the wrong and wished to remedy it. There was the easy, rapid, and unfruitful parliamentary way; there was the way—slow, up-hill, but very rich in after-fruits—of appealing directly to the people to reform the thing for themselves. I know this last way would have been slow. I know that all those who wish to gather fruit before the tree is planted would have exclaimed, "And meanwhile the children are left to suffer." I know it would have required a personal devotion and belief in their work far greater than that which is necessary for conducting a parliamentary agitation, with its showy and rather sensational rewards; but I also know that in the end the parent would not simply be rendering mechanical obedience to a law; I know that vigilant individual care and intelligent appreciation of the interests of their children would, as a consequence, have slowly grown to be a part of their character. How can these things ever grow into being, if by a compulsory law you make them as regards each special case in turn unnecessary? Did anything in this world ever come into being if you had rendered its growth superfluous? What is it that develops all the best qualities of human nature? Simply the pressure upon us of those natural pains

and penalties that follow the absence of these qualities; then the intelligent perception that we are meant for our happiness to have these qualities; then the moral attachment to these qualities that is developed as we struggle to have them. But how can any of these things be if you step in between the man and Nature's way of teaching him with your hasty and ill-advised compulsions? The parent's treatment of the child, as regards his labor, had been both to parent and child an ever-growing, an ever-widening education, if you had had a little more patience as regards learning Nature's ways, and a little less arrogance as regards your own methods.

And now see to-day the second chapter that is already following on the first. Over a long series of years we have been congratulating ourselves upon the philanthropy of these acts and their excellent effect upon the people. A universal system of national education accompanied with compulsion has succeeded to the acts as their logical complement; and now to-day—thanks to the efforts of a few discerning people who have not simply followed a fashion in this matter—we wake to find that we are applying this system in such a hasty and reckless manner that we are injuring the very brains and bodies that we intended to benefit. Of course, the responsible office can not see the mischief—what public office ever did see or understand the more remote and less direct consequences of its actions? Of course, the great mass of parents that have let the education and management of their children slip practically out of their hands, that have measured their duties by an official regulation, that have allowed a group of worthy gentlemen at Whitehall to think and act for them, and have accepted so much public cash for thus morally effacing themselves, that, in a word, are drowsing while others care for and control the very greatest of their interests, have, just so far as they have done this, disqualified themselves from exercising a wise and intelligent discernment as to where the true loss and the true gain lie. How can it be otherwise? All great state systems stupefy. Without dwelling upon the oppressive uniformity; the sacrifice of some to others, and of all to official mediocrity; the stiff wooden parts; the pedantries and complexities that accompany all attempts at official nursing of a nation; the hard and fast regulations that turn grants of public money into a curse and not a blessing; the moral deterioration that results from marrying together one of the noblest of all desires, that of gaining more knowledge, with the meanest of all precautions, "Let us do it at the public expense"—leaving all this out of consideration, the one great fact remains, sufficient in itself to damn the whole thing, that where you have a national and uniform system, there you necessarily have two political parties struggling for its management and blotting out all individual choice and perception by the discipline—in an intellectual sense the brutalizing discipline—that each party for the sake of defeating its opponent learns to submit to. All discipline for fighting pur-

poses brutalizes in this sense. It deprives men of more than half their perceptions. And so it comes naturally about that, having adopted the very best means to make ourselves thoroughly stupid about education—first, by factory acts, and then by their logical completion, a universal state system—we now find ourselves face to face with dangers, the very possibility of which, in our hurry to manufacture intelligence by state machinery, had never occurred to us. But this frightful and almost immeasurable evil of over-pressure, which is certainly not going to be charmed out of existence by any number either of indignant or persuasive minutes written with an undisguised odor of office about them by my friend Mr. Fitch, is not the only sign that you can not make the state a parent without the logical consequence of making the people children. Some years ago we were startled by the reports of the ill-adapted food on which children in certain parts of the manufacturing districts were fed, or rather were not fed; we were startled by the high death-rate of very young children in certain towns. Yet we might have known it would be so. These are the necessary fruits of all such legislation as that of factory acts or of state education and compulsion, which forces on parents a certain view of their duty instead of leaving them, slowly and painfully though it may be, to learn it intelligently for themselves. Official regulation and free mental perception of what is right and wise do not and can not coexist. I see no possible way in which you can reconcile these great state services and the conditions under which men have to make true progress in themselves. At least, if you are to do so, you must first get rid of certain great facts in nature. At present we live under the condition which, unfortunately, seems likely to last our time or a little longer, that no great human qualities are developed where you take away the opportunities for their development, that they do not grow spontaneously and without pressure, that each action by which for the moment the good and the bad are placed on the same level—for example, the selfish and the unselfish parent, or the drunkard and the sober man—tends to delay the emergence of the better type out of the inferior type. Every such kind of action relieves the unworthy of the consequences of their actions, and takes from the worthy the occasions of acquiring, and preserving, and strengthening those qualities that are good and useful. In a word, so far as you are able to do it for the moment, you make goodness unnecessary; and as unfortunately the world was constructed on a plan which makes goodness an essential element in obtaining happiness, you are trying to go by one road while Nature is trying to go by another. My two friends, Mr. Mundella and Sir W. Lawson, both of them against their will architects of national incapacity, may quarrel with my verdict on their work, but, quarrel or not, they are both doing their best—the one to make temperance and the other to make the intelligent care of parents for their children an unnecessary part of human nature. They are both throwing all the

power and influence that are in their hands on the side of the inferior type; they are both, so far as they can do it, preventing the development of the better type. They are both manufacturing virtues which are the mere imitations of virtues, sham products that, as time will tell them, will neither wash nor wear. Many men before them have tried a fall with Nature and her conditions, and have scarcely had the best of it. Nature in her irony often allows us a ten minutes of seeming success when we go against her methods, and I doubt not that both Sir W. Lawson and Mr. Mundella will have a ten minutes of their own; but then comes the after-time in which the bent bow flies back. I hope as it does so it may not hit any of my friends too violently in the face who have been so strenuously bending it down.

## BLOODY SWEAT.

By J. H. POOLEY, M.D.,

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THIS rare affection, which has always excited in a high degree the interest and attention of medical observers, consists essentially of a hæmorrhage from the unbroken surface of the skin. But, inasmuch as it takes place from the net-work of small vessels which surround the sweat-glands, and makes it appearance through the opening of the sweat-ducts, it is not inappropriately, after all, named "bloody sweat."

The discharge is generally intermittent, or at least remittent, and paroxysmal in its nature, the intervals varying from a few hours to months. Sometimes it is pure blood which coagulates in crusts or gouts upon the surface, sometimes it is so intermixed with serum or the perspiratory fluid as to be merely a more or less deeply colored bloody liquid.

Its extent varies extremely: it may make its appearance over the whole or nearly the whole of the surface of the body, but more commonly it is confined to some selected regions, generally those in which the skin is thin and delicate. It most frequently appears as a more or less copious and continued oozing from the surface, which, when wiped away, rapidly or slowly reappears from numerous minute or indistinguishable points, but it has been seen to spring up in a distinct jet from the surface.

It is often associated with eruptions upon the skin, but quite as often there is nothing of the kind. Every age and both sexes have furnished examples of it, though it is most common in females, and especially in nervous and hysterical women. Bloody sweat may be pro-

duced by overwhelming mental emotions, and marks the acme of such perturbing passions as terror, anguish, despair, etc.

In these cases and some others it appears to be the result of a purely nervous impression; while in still others, as in malarial fevers, of which it has been known to form a complication, the immediate cause is of a somewhat different nature. While in some cases it has been associated with scurvy, purpura, and other blood-diseases, this has not generally been the case. It has been simulated chiefly by enthusiastic and dishonest pietists.

Examples of the affection may be found extending throughout the whole range of medical literature, as well modern as ancient, and from a study of these we shall best be able to bring into view its numerous and varying phases.

The eminent French historian De Thou mentions the case of an Italian officer who commanded at Monte-Maro, a fortress of Piedmont, during the war in 1552 between Henry II of France and the Emperor Charles V. This officer, having been treacherously seized by order of the hostile general, and threatened with public execution unless he surrendered the place, was so agitated at the prospect of an ignominious death that he sweated blood from every part of his body.

The same writer relates a similar occurrence in the person of a young Florentine at Rome, unjustly put to death by the order of Pope Sixtus V, in the beginning of his reign, and concludes the narration as follows: "When the youth was led forth to execution, he excited the commiseration of many, and through excess of grief was observed to shed bloody tears, and to discharge blood instead of sweat from his whole body—a circumstance which many regard as a certain proof that Nature condemned the severity of a sentence so cruelly hastened, and invoked vengeance against the magistrate himself, as therein guilty of murder."

Among several examples, given in the German "Ephemerides," of bloody tears and bloody sweat occasioned by extreme fear, more especially the fear of death, may be mentioned that of "a young boy who, having taken part in a crime for which two of his elder brothers were hanged, was exposed to public view under the gallows on which they were executed, and was thereupon observed to sweat blood from his whole body."

It is mentioned by Theophrastus, and by Aristotle, who says, "Some have a bloody sweat," and again, "Some through an ill habit of body have sweat a bloody excrement."

And Diodorus Siculus says of the Indian serpents that, if any one be bitten by them, he is tormented with excessive pains, and seized with a bloody sweat. Galen observes, "Contingere interdum poros ex multo aut fervido spiritu adeo dilatari, ut etiam exeat sanguis per eos fiatque sudor sanguineus" (Sometimes the pores become so much dilated by rapid or fervid breathing that the blood oozes out

through them, and is made a bloody sweat); while Lucan thus describes it:

" . . . Sic omnia membra
Emisere simul rutilum pro sanguine virus.
Sanguis erant lacrymae; quacumque foramina novit
Humor, ab his largus manat cruor; ora redundant,
Et patulae nares; sudor rubet; omnia plenis
Membra fluunt venis; totum est pro vulnere corpus."

(Thus all the limbs together emitted a red humor the same as blood. The tears were blood; and whatever openings the humor knew, from them flows copious bleeding; the mouth and the distended nostrils overflow; the sweat is red; the veins flow full in all the limbs; the whole body is as if it were a wound.)

The detestable Charles IX of France sank under this disorder, thus described by Mezeray ("Histoire de France," vol. iii, p. 306): "La nature fit d'étranges efforts pendant les deux dernières semaines de la vie de la roi. Il s'agitait et se remuait sans cesse; le sang lui rejaillait par les pores et partout les conduits de son corps. Après avoir long-temps suffert, il tomba dans une extreme faibleur et rendit l'âme." (Nature made strange efforts during the last two weeks of the life of the king. He was in constant agitation and motion; the blood gushed out from his pores and from all the conduits of his body. After having suffered a long time, he fell into an extreme weakness and gave up his soul.) The same historian relates the case of the governor of a town taken by storm, who was condemned to die, and was seized with a profuse sweating of blood the moment he beheld the scaffold. Lombard mentions a general who was affected in a similar manner on losing a battle. The same writer tells us of "a nun who was so terrified when falling into the hands of ruthless banditti that blood oozed from every pore." (Schenck, apparently referring to the same case, says that she died of the hæmorrhage, in the sight of her assailants.)

Henry ab Heer records the case of a man who not only labored under bloody sweat, but small worms also accompanied the bloody secretion. These were undoubtedly vermicular or worm-like coagula, or clots, formed in the sweat-ducts.

In the memoirs of the Society of Arts of Haarlem we read of the case of a sailor, who, falling down during a storm, was raised from the deck streaming with blood. At first it was supposed that he had been wounded, but on close examination the blood was found to flow from the surface of the body.

Fabricius de Hilden mentions a case that came under the observation of his friend Sporlinus, a physician of Bale: the patient was a child twelve years of age, who never drank anything but water; having gone out into the fields to bring home his father's flocks, he stopped upon the road, and, contrary to habit, drank freely of white wine. He shortly after was seized with fever. His gums first began to

bleed, and soon after a hæmorrhage broke out from every part of the integuments, and from the nose. A case is also related of a widow, forty-five years of age, who had lost her only son. She one day fancied that she beheld his apparition beseeching her to relieve him from purgatory by her prayers, and by fasting every Friday. The following Friday, in the month of August, a perspiration tinged with blood broke out. For five successive Fridays the same phenomenon appeared. The blood escaped from the upper part of the body, the back of the head, the temples, the eyes, the nose, the breast, and the tips of the fingers. The disorder disappeared spontaneously on Friday, the 8th of March in the following year.

This affection was evidently occasioned by superstitious fears; and this appears more probable from the periodicity of the attacks. The first invasion of the disease might have been purely accidental; but the regularity of its subsequent appearance on the stated day of the vision may be attributed to the influence of apprehension. Bartholinus mentions cases of bloody sweat taking place during vehement terror, and the agonies of torture.

The case of Catherine Merlin, of Chamburg, is well authenticated, and worthy of being recorded. She received a kick from a bullock over the pit of the stomach, that was followed by vomiting of blood; this discharge having been suddenly stopped by her medical attendants, the blood made its way through the pores of various parts of her body, every limb being affected in turn. The sanguineous discharge was preceded by a pricking and itching sensation. The discharge usually occurred twice in the twenty-four hours; and on pressing the skin the flow of blood could be accelerated and increased. Dr. Fournier relates the case of a magistrate who was attacked with bloody sweat after any excitement, whether of a painful or a pleasurable nature.

In his "Commentaries on the Four Gospels," Maldonato refers to a robust and healthy man at Paris, who, on hearing sentence of death passed on him, was covered with a bloody sweat. Zacchias mentions a young man who was similarly affected on being condemned to the flames. The following case is quoted, in the "Medico-Chirurgical Review," from the French "Transactions Médicale" for November, 1830: A young woman, aged twenty-one years, of indolent habits and obstinate temper, had been much irritated by some reflections made by her parents on account of her abjuring the Protestant religion. She left the parental roof, and, after wandering about for some time, took up her residence in a hospital. She was then suffering from violent attacks of hysteria, attended with general convulsions. After paroxysms of hysteria, which sometimes lasted twenty-four or thirty-six hours, this young woman fell into a kind of ecstasy, in which she lay with her eyes fixed, sensibility and motion suspended. Sometimes she muttered a prayer, but the most remarkable phenomenon was an exudation of

blood from the cheeks and the surface of the abdomen in the form of perspiration. The blood exuded in drops, and tinged the linen. This bloody perspiration took place whenever the hysteric paroxysm lasted a considerable time.

J. C. Schilling relates the case of a boy, twelve years of age, who was relieved from a severe comatose and convulsive disorder by a bloody sweat which broke out August 2, 1747.

The following note on this subject is from Dr. Schneider, a celebrated German physician: He mentions having been once summoned to a healthy man, fifty years of age, who, for a period of twelve months in succession, had traveled on foot; during the journey he had perspired much in his feet; and, on examining them at the end of it, they were found covered as high as the ankles with a sanguineous perspiration, which had also soaked into and stained his stockings. He quotes, among others, the following remarkable case from Paulini: While surgeon on board a vessel, a violent storm arose, and threatened immediate destruction to all. One of the sailors, a Dane, thirty years of age, with fair complexion and light hair, was so terrified that he fell speechless on the deck. On going to him, Paulini observed large drops of perspiration of a bright-red color on his face. At first, he imagined the blood came from the nose, or that the man had injured himself by falling; but, on wiping off the red drops from his face, he was astonished to see fresh ones start up in their place. The colored perspiration oozed out from different parts of the forehead, cheeks, and chin; but was not confined to these parts, for, on opening his dress, he found it formed on the neck and chest. On wiping and carefully examining the skin, he distinctly observed the red fluid exuding from the openings of the sweat-ducts. So deeply stained was the fluid that, on taking hold of the handkerchief with which it was wiped off, the fingers were made quite bloody. As the bloody perspiration ceased, the man's speech returned; and when the storm passed over he recovered, and remained quite well during the rest of the voyage.

Erasmus Wilson, in his work on "Diseases of the Skin," mentions two cases which had come under his own observation, and refers to three others. M. Du Gard has recorded the case of a child three months old that was taken with bleeding at the nose and ears, and on the hinder part of the head, which lasted for three days, and afterward the nose and ears ceased bleeding, but still the blood-like sweat came from the head. Three days before the death of the child, which happened the sixth day after it began to bleed, the blood came more violently from its head, and streamed out to some distance. It also bled on the shoulders and at the waist; and for three days at the toes, at the bend of its arms, at the joints of the fingers, and at the finger-ends.

Dr. John Mason Good remarks that ephidrosis cruenta, which he

defines as cutaneous perspiration intermixed with blood, has taken place during vehement terror, and not unfrequently during the agony of hanging, or the torture. It is said, also, in some instances, to have occurred in new-born infants, probably from the additional force given to the circulation in consequence of a full inflation of the lungs, accompanied with violent crying.

The following remarkable case is related by Hebra, in his work on "Diseases of the Skin": "The patient was a young man, strong and well-nourished, who was attacked repeatedly by hæmorrhage from the surface of the lower limbs. This generally occurred during the night, so that he first became aware that the bleeding had taken place by finding the sheets stained with spots of blood when he awoke. I once, however, saw blood flow from the uninjured back of the hand of this patient while he was sitting near me at table. The blood formed a jet, which would about correspond in size to the duct of a sweat-gland. This jet had also a somewhat spiral form, and rose about one line above the surface of the skin." An exceedingly interesting case was reported by Dr. Hart, in the "Richmond and Louisville Medical Journal," January, 1875, p. 98.

The most recent case that I have found is the following from an informal "Report of the Proceedings of the King William County (Virginia) Medical Association," by George William Pollard, M. D., and published in the "Virginia Medical Monthly" for January, 1880, p. 816: "Among a number of interesting cases reported at the last meeting of the King William County Medical Association, was one by Dr. R. G. Hill, of bloody sweat, the subject being a boy four years of age, suffering from malarial fever.

"During each sweating stage, blood oozed from the face and neck. Febrifuges followed by quinine afforded relief; but two months later he was taken with hæmorrhage from the bowels. This condition was accompanied with vomiting of blood, from which he died."

I have been able to collect in all forty-seven cases of this strange and interesting disorder; and, when we consider the long period over which this research extends and the tolerable certainty that every case of this kind has found its way into print, this number may surely be received as an indication that it is extremely rare. One of the lower animals, the hippopotamus, sweats blood, at least when brought to this country and kept in a state of confinement, as I myself have witnessed; the instance thus seen occurred during hot weather in the latter part of summer.

As already stated, sweating of blood has been simulated by religious enthusiasts, the following instructive example of which is taken from Hebra: "More than ten years ago there lived in a village not far from Vienna a woman who was said to take neither food nor drink, and who asserted that every Friday, between the hours of 10 A. M. and noon, hæmorrhage occurred spontaneously from her skin at

various points, but especially from her face, feet, and hands. The parts were, in fact, said to be the same from which blood flowed during the crucifixion of our Lord. Now, as this occurrence created a great sensation in the neighborhood, and attracted numerous pilgrims from all parts of the country, the authorities found themselves compelled to make a thorough investigation of the matter. Dr. Haller, a physician who held a high position in the General Hospital at Vienna, was sent to the spot, with the necessary staff of police, in time to place the woman under surveillance on a Thursday, and to bring her before the Friday to Vienna. Here she was placed in a room, so that she could be watched uninterruptedly night and day, by medical men. The Friday came, and the woman did not bleed. She, however, took nothing that day nor till the evening of Saturday, when, tormented by hunger, she asked for food, and ate a considerable quantity. From this time she took nourishment regularly, and the hæmorrhage never returned. The case just related is probably similar to not a few others which are recorded in the history of spontaneous hæmorrhages (under the name of stigmata, etc.), but which were never brought into the clear light of scientific investigation, so as to be examined without prejudice and—*explained.*"

These impostors, the so-called stigmata, still make their appearance from time to time in Catholic countries, as is shown by a cheap publication evidently intended for circulation among the ignorant faithful, which I recently came across, and which has the following extended title-page: "Letter from the Earl of Shrewsbury to Ambrose Lisle Philips, Esq., descriptive of the Ecstatica of Caldasa, and the Addolorato of Caspiana; being a second edition, revised and enlarged; to which is added the Relation of Three Successive Visits to the Estatica of Monte Sansavino, in May, 1842. First American, from the last revised London edition; with Additional Letters now first published; bringing the Narrative down to 1842. '*It is honorable to reveal and confess the works of God*' (Tobias xii, 7). New York, 1843."

In this publication fifty similar cases are adduced, which are said to have received the attestation of the Church. Of those with which the book itself is concerned, one is said to eat nothing but a little fruit; of another it is asserted: "Indeed, she may be truly said to subsist upon air; for, on the 15th of August next, it will be *eight years complete since she ate, drank, or slept!*" (Where is Dr. Tanner after this?)

It is a noteworthy fact that these cases were all those of poor peasant-girls, in secluded, out-of-the-way hamlets, among a rustic and ignorant population; they were plainly hysterical and cataleptic, visited by hundreds of wondering, half-adoring spectators, who were ready to fall down and worship them. We have here everything that could stimulate and aid deception, and nothing at all of

the "clear light of scientific investigation" to which Hebra's case was subjected.

With regard to the so-called bloody sweat of our Saviour, such an undoubted article of faith to many, and so familiar to our ears in the pathetic invocation of the Litany of the Episcopal Church, "By thine agony and bloody sweat," the once celebrated Dr. Mead makes the following observations in his "Medica Sacra": "Saint Luke relates of Christ himself that, when he was in an agony by the fervency of his prayers, his sweat was like drops of blood falling down on the ground. This passage is generally understood as if the Saviour of mankind had sweated real blood. But the text does not say so much. The sweat was only *hosoi thromboi* AIMATOS, as it were, or like drops of blood; that is, the drops of sweat were so large, thick, and viscid, that they trickled to the ground like drops of blood. Thus were the words understood by Justin Martyr, Theophylactus, and Euthymius."

Beza's Latin Testament renders the words, "Erat autem sudor ejus quasi grumi sanguinis descendentes in terram." (But his sweat was as drops of blood falling upon the earth.)

Luther's German version has, "Es ward aber sein Schweisz wie Blutstropfen die fielen auf die Erde." (But his sweat was as drops of blood that fell upon the earth.)

The Rhemish Testament, from the Vulgate of Jerome, gives in the translation recognized by the Catholic Church in this country, "And his sweat became as drops of blood trickling down upon the ground."

Our authorized version, "And his sweat was as it were great drops of blood falling down to the ground."

The recent revision changes only a single word, making it, "And his sweat became as it were great drops of blood falling down upon the ground."

Among modern commentators some agree with Whitby, who says, "I own that these words do not certainly signify that the matter of this sweat was blood, but only that it was like to blood, being in such large drops." But the majority hold with Alford, that it was a veritable bloody sweat.

Adam Clarke contends that the passage must be interpreted according as the emphasis is made to rest on *thromboi*, or *aimatos*, and unhesitatingly declares for the latter.

Perhaps it would be better not to add anything to the judicious and non-committal remarks of Dr. Mead, but still I will hazard the following considerations: It is difficult to understand why, if Luke, a clear writer and said to be a physician, wished to state the fact of a bloody sweat, he could not have done so in plain, straightforward language, with no ambiguity about it. If he was, as it is said, a physician, the simile of dropping blood, not an unnatural one in any case for profuse sweat, would be all the more natural and likely to be used.

In the gloom of the garden the color would not be noticed, though the profuseness of the sweat, as its falling proved, might; furthermore, if it had been blood it would have left stains, if not crusts or coagula behind it, and excited still further notice and remark. From all these considerations I think we have reason enough to conclude that this case of bloody sweat exists only in the affectionate and pious fancy of the Church—come down to us from the former ages, when men would rather believe than examine, and left undisturbed even to these times, when, alas! men would, as a rule, rather examine than believe.

## PROTECTIVE MIMICRY IN MARINE LIFE.

By Dr. WILHELM BREITENBACH.

BY mimicry we understand the assumption by animals of a deceptive similarity answering a protective purpose, not only to other animals, but also to lifeless objects, and, in color, to the surroundings. In a biological application, this definition of the term, though different from the common one, is well founded; for similarity of an animal with any object affords it protection, by enabling it to approach its prey unobserved; by facilitating its escape from enemies; or by shielding it, under cover of its resemblance to unpleasant objects, from hostile attacks. A number of observations have been published, by various well-known authors, upon the interesting phenomena of mimicry, but they have related generally to land animals, while the cases of the occurrence of similar phenomena among the inhabitants of the sea have been less extensively noticed. A few have been mentioned by Haeckel and Carus Stern, but I have others, of not less high interest, to describe.

On my voyage from Brazil to England in July, August, and September, 1883, I had many opportunities to secure and examine closely specimens of pelagic life. From the 30th of August to the 5th of September, we crossed the Sargasso Sea, between latitude 25° 12′ and 34° 39′, and longitude 33° 52′ and 35° 52′ west. The sea-weeds were not massed in extensive fields, but were distributed in single groups of larger or smaller size, and these were driven by the wind in nearly straight lines, that could be followed with the eye to considerable distances. The linear arrangement was also made distinct to me by its pelagic life, particularly by its great colonies of radiolaria, or polycyttaria, salpæ, and other orders. Thus, I find in my notes such items as, "September 3d, polycyttaria in colossal masses, thick, wide bands of them stretching along for miles; September 14th, immense masses of little salpæ and polycyttaria, causing the water to display milky bands."

I did not neglect to fish up masses of the Sargasso sea-weed every

day and examine it through and through for its fauna, and whenever I did this I found many notable cases of mimicry. The color of the younger plants is a yellowish green, while the older stalks are of a more or less dark brown. A luxuriant animal life flourishes on the stems, leaves, and air-vessels of the Sargasso-weed. Little actiniæ, sometimes of a light, sometimes of a dark-brown color, were very numerous on the plants I most closely examined; often so thick as to completely cover the stems. On the same plants, I also found numerous specimens of small, naked snails. These minute gasteropods, a centimetre or a centimetre and a half long, bore on their backs numerous retractile tentacles, arranged in cross-rows at various intervals. In color, they were of various shades of brown, like the actiniæ; when they drew themselves up so that the tentacles stood thickly together, they so much resembled the actiniæ that it would be a matter of difficulty to a person not acquainted with both animals to tell them apart. Another snail, whose tentacles were arranged in rows along each side of the back, was still more difficult to distinguish when any danger threatened it from the actiniæ. Of what use can the resemblance to the actiniæ be to the little mollusks? They are, it is true, great eaters of the actiniæ, for I have seen one of them devour four or five of those animals in an hour; but it does not appear that their access to them is greatly facilitated by the resemblance, for the actiniæ are so confined by the limitation of their movements as to be unable, in any case, to escape their more facile enemies. We are, therefore, reduced to consider the likeness a case of mimicry for the protection of the snails against animals which pursue them, but avoid the actiniæ, whose nettle-cells are by no means pleasant morsels. But as I have not been able to discover what special enemies the snails have, and whether they really dislike the actiniæ, my attempted explanation must remain an attempt, to be confirmed or disproved by some future observer in the Sargasso Sea, who can begin where I have had to leave off. Other cases of mimicry on the part of mollusks have come under observation. According to Dr. H. von Ihering, the *Chromodoris gracilis* lives associated with a sponge (*Suberites*), and is colored like it, blue.

On the same sea-weed I found other larger mollusks, which, not resembling other animals, so strikingly resemble the forms of the stems and leaves of the plants that it is extremely difficult to find them in the tangle of brush. They have developed flaps all around their bodies, before and behind, and on either side, the edges of which are irregularly serrated, with the tips of the serratures of a brown tint like the older alga-stems. The surface of the flaps, and of a part of the rest of the body, is beset with numerous small similarly brown-tipped teeth, while the color of the animal as a whole is olive-green, like that of the plant in which it lives.

Moritz Wagner regards the phenomena of mimicry as the consequence of an innate caution in the animal, that causes it to choose those

places for its abode with which it most corresponds in color. Dwelling on this point, he remarks that "the instinct of self-preservation native to all animals, which sharpens their senses against incessantly threatening dangers, prompts marine as well as land animals to seek dwelling-places similar to themselves in form and color." Any person who has had opportunity, as I have, to watch the little crabs and shrimps, that swim around in the alga-groups of the Sargasso Sea, for half a day at a time, will have to admit that there is much in this view, though it will not be necessary to throw away the theory of selection. I can not say whether the crab I have observed is the same that Wagner describes as *Nautilo graspus minutus*. I have collected several hundreds of the animals, and think, after superficial observation, that I can distinguish more than one species among them, while the variability, especially in color, is wonderful. The adaptation of the innumerable tints to every grade of change in the color of the sea-weed is really marvelous. The younger, lighter green crustaceans are always to be found on the young, verdant fronds of the plant, while the older parts of the weed are inhabited by older, brown animals. The older stems are often incrusted with the white shells of bryozoa, and corresponding with these we are sure to find white spots on the brown armor of the crabs. The legs of the animals are frequently of an olive-green ground with brownish spots, deceptively like the slender sea-weed-leaves that are just beginning to turn brown. If one will, as I did, pull one of the large plants upon the deck, leave it in a cask of sea-water for an hour or two, and then look through it for crabs without disturbing it, he will find it very hard to discover three or four of the animals, although he may be sure there are a quarter of a hundred of them there; and, if he gives the mass a lively shake, he will find a curious assemblage of the most varied sorts tumbling off the bush, whose behavior will go far to verify Wagner's view; for, if they are allowed the opportunity, they will all swim back to the sea-weed, and each will seek a part of the plant most like it in color. I tried the experiment forty or fifty times, and never saw a little green crab settle on a dark-brown stem. The crustaceans keep to their color, and the brown ones will, with amazing speed, dart through the thick net-work of stems and leaves, to the darkest spot they can find, where they quickly escape observation.

I remarked another striking example of what might be considered intelligent mimicry in a crab, on the 11th of September, after we had got out of the Sargasso Sea. Toward night a piece of dark-brown bark, about as large as one's hand, floated close by the ship. Thinking I might find something upon it, I fished it up with a scoop I had prepared for such purposes and which I had found very useful, and put it in a pail of fresh sea-water for observation. While I stood looking at it, I perceived motions of legs and tentacles, and then discovered a crab, so precisely of the color of the bark, that it might have lain on

it a long time, had it not moved, before I would have noticed it. I called the attention of the captain of the ship to the object, and he examined it for some minutes, the crab not moving, before he saw anything but bark. How came this brown crab, on a piece of wood of precisely the same color, in the middle of the ocean? Must we believe that several crabs got on the bark, among them the brown one, and that the struggle for existence resulted in his being the only one left? I am satisfied that we can come to no other conclusion than Wagner's, and that we must believe that a conscious or perhaps an instinctive choice governed the animal in settling upon an object so like it in color. The bark was probably occupied while floating among the sea-weed, then drifted away to the spot where it was found, and where it furnished so singular an isolated example of selective mimicry. I found numerous slender fishes in the algæ of the Sargasso Sea, likewise protected by their resemblance in color to the plants among which they lived. One afternoon, after I had examined a plant for an hour for crabs, I took it out of the pail to throw it into the sea, when a fish about the size of a lead-pencil fell out of it. I put the fish into another pail, in which there was also a sea-weed. It instantly vanished from my sight, and I had to look for some time among the thick stems before I could find it again.

I do not know whether any of these observations have been recorded before. During my residence in Brazil, I had but limited opportunities to keep acquainted with recent zoölogical literature. But I found my sail through the Sargasso Sea full of interest, and I believe that a voyage there would be fraught with pleasure and profit to every naturalist. It is not so very expensive, either; and can easily be made on a schooner or bark sailing from a European port to the West Indies. My passage from Porto Allegro in Southern Brazil, to Falmouth, England, from the 15th of June to the 25th of September, cost me, board included, less than seventy-five dollars. Such a voyage furnishes, moreover, at the same time, an opportunity to make a personal acquaintance with the natural history of tropical regions.—*Translated for the Popular Science Monthly from Kosmos.*

## THE CHEMISTRY OF COOKERY.

By W. MATTIEU WILLIAMS.

### XLII.—STIMULANTS AND CONDIMENTS.

BEFORE proceeding further, I must fulfill the promise made in No. 39 to report the results of my repetition of the Indian process of preparing *samp*. I soaked some ordinary Indian corn in a solution of carbonate of potash, exceeding the ten or twelve hours

specified by Count Rumford. The external coat was not removed even after two days' soaking, but the corns were much swollen and softened. I suspect that this difference is due to the condition of the corn which is imported here. It is fully ripened, dried, and hardened, while that used by the Indians was probably fresh gathered, barely ripe, and much softer.

Mr. Gaubert (No. 1,373, page 185) asks me whether I think that tea taken in moderation (say two cups in the evening) does any mischief. If he carefully reads No. 40, he will find the answer already given before his question was asked. He offers to relinquish the habit, in spite of the pang, "on the advice of so eminent an authority" as myself. I hope that he will not be so weak as to accept my authority or any other on a question which can easily be answered by common sense and simple direct experiment. There are cases in which we are compelled to lean on authority, but this is not one of them, and he will see, by reperusing what I have written on the subject, that I have repudiated mere authority, and appealed to facts that are open to all.

I will reply further to Mr. Gaubert, as in doing so I shall be also replying to a multitude of others, his case being typical. Let any of these repeat the experiment that I have made. After establishing the habit of taking tea at a particular hour, suddenly relinquish it altogether. The result will be more or less unpleasant, in some cases seriously so. My symptoms were a dull headache and intellectual sluggishness during the remainder of the day—and if compelled to do any brain-work, such as lecturing or writing, I did it badly. This, as I have already said, is the diseased condition induced by the habit. These symptoms vary with the amount of the customary indulgence and the temperament of the individual. A rough, lumbering, insensible navvy may drink a quart or two of tea, or a few gallons of beer, or several quarterns of gin, with but small results of any kind. I know an omnibus-driver who makes seven double journeys daily, and his "reg'lars" are half a quartern of gin at each terminus—i. e., 1¾ pint daily, exclusive of extras. This would render most men helplessly drunk, but he is never drunk, and drives well and safely.

Assuming, then, that the experimenter has taken sufficient daily tea to have a sensible effect, he will suffer on leaving it off. Let him persevere in the discontinuance, in spite of brain-languor and dull headache. He will find that day by day the languor will diminish, and in the course of time (about a fortnight or three weeks in any case) he will be weaned. He will retain from morning to night the full, free, and steady use of all his faculties; will get through his day's work without any fluctuation of working ability (provided, of course, no other stimulant is used). Instead of his best faculties being dependent on a drug for their awakening, he will be in the condition of true manhood—i. e., able to do his best in any direction of effort, simply in

reply to moral demand; able to do whatever is right and advantageous, simply because his reason shows that it is so. The sense of duty is to such a free man the only stimulus demanded for calling forth his uttermost energies.

If he again returns to his habitual tea, he will again be reduced to more or less of dependence upon it. This condition of dependence is a state of disease precisely analogous to that which is induced by opium and other drugs that operate by temporary abnormal cerebral exaltation. The pleasurable sensations enjoyed by the opium eater or smoker or morphia-injector are more intense than those of the tea-drinker. Mr. Gaubert tells us that he enjoys his cup "immensely." The gin-drinker enjoys his half quartern "immensely," as anybody may see by "standing treat" and watching the result. The victim of opium has enjoyment still more immense, and in every case the magnitude of the mischief is measurable by the immensity of the enjoyment.

Again I say that I am not denouncing the proper use of any of these things. There are occasions when artificial stimulants or sedatives cautiously used are most desirable. My condemnation is applied to their *habitual* use, and the physical and moral degradation involved in the slavish dependence upon any sort of drug, especially when the drug operates most powerfully on the brain. To the brain-worker tea is worse than alcohol, because it exaggerates his special liability to overstrain. I can detect by physiognomical indications the habitually excessive tea-drinker as readily as I can detect the physiognomy of the opium-victim, as may anybody else who chooses to make careful observations.

I must not leave this subject without a word or two in reference to a widely prevailing and very mischievous fallacy. Many argue and actually believe that, because a given drug has great efficiency in curing disease, it must do good if taken under ordinary conditions of health.

No high authorities are demanded for the refutation of this. A little common sense properly used is quite sufficient. It is evident that a medicine, properly so called, is something which is capable of producing a disturbing or alterative effect on the body generally or some particular organ. The skill of the physician consists in so applying this disturbing agency as to produce an alteration of the state of disease, a direct conversion of the state of disease to a state of health, if possible (which is rarely the case), or more usually the conversion of one state of disease into another of milder character. But, when we are in a state of sound health, any such disturbance or alteration must be a change for the worse, must throw us out of health to an extent proportionate to the potency of the drug.

I might illustrate this by a multitude of familiar examples, but they would carry me too far away from my proper subject. There is,

however, one class of such remedies which are directly connected with the chemistry of cookery. I refer to the condiments that act as "tonics," excluding common salt, which is an article of food, though often miscalled a condiment. It is food simply because it supplies the blood with one of its normal and necessary constituents, chloride of sodium, without which we can not live. A certain quantity of it exists in most of our ordinary food, but not always sufficient.

Cayenne pepper may be selected as a typical example of a condiment properly so called. Mustard is a food and condiment combined; this is the case with some others. Curry-powders are mixtures of very potent condiments with more or less of farinaceous materials, and sulphur compounds, which, like the oil of mustard, of onions, garlic, etc., may have a certain amount of nutritive value.

The mere condiment is a stimulating drug that does its work directly upon the inner lining of the stomach, by exciting it to increased and abnormal activity. A dyspeptic may obtain immediate relief by using cayenne pepper. Among the advertised patent medicines is a pill bearing the very ominous name of its compounder, the active constituent of which is cayenne. Great relief and temporary comfort are commonly obtained by using it as a "dinner-pill." If thus used only as a temporary remedy for an acute and temporary, or exceptional, attack of indigestion, all is well, but the cayenne, whether taken in pills or dusted over the food or stewed with it in curries or any otherwise, is one of the most cruel of slow poisons when taken *habitually*. Thousands of poor wretches are crawling miserably toward their graves, the victims of the multitude of maladies of both mind and body that are connected with chronic, incurable dyspepsia, all brought about by the habitual use of cayenne and its condimental cousins.

The usual history of these victims is that they began by overfeeding, took the condiment to force the stomach to do more than its healthful amount of work, using but a little at first. Then the stomach became tolerant of this little, and demanded more; then more, and more, and more, until at last inflammation, ulceration, torpidity, and finally the death of the digestive powers, accompanied with all that long train of miseries to which I have referred. India is their special fatherland. Englishmen, accustomed to an active life at home, and a climate demanding much food-fuel for the maintenance of animal heat, go to India, crammed, may be, with Latin, but ignorant of the laws of health; cheap servants promote indolence, tropical heat diminishes respiratory oxidation, and the appetite naturally fails. Instead of understanding this failure as an admonition to take smaller quantities of food, or food of less nutritive value, they regard it as a symptom of ill-health, and take curries, bitter ale, and other tonics or appetizing condiments, which, however mischievous in England, are far more so there.

I know several men who have lived rationally in India, and they all

agree that the climate is especially favorable to longevity, provided bitter beer, and all other alcoholic drinks, all peppery condiments, and flesh foods, are avoided. The most remarkable example of vigorous old age I have ever met was a retired colonel eighty-two years of age, who had risen from the ranks, and had been fifty-five years in India without furlough; drank no alcohol during that period; was a vegetarian in India, though not so in his native land. I guessed his age to be somewhere about sixty. He was a Scotchman, and an ardent student of the works of both George and Dr. Andrew Combe.

While still seasonable I add by way of postscript a receipt for a dish lately invented by my wife. It is vegetable marrow *au gratin*, prepared by simply boiling the vegetable as usual, slicing it, placing the slices in a dish, covering them with grated cheese, and then browning slightly in an oven or before the fire, as in preparing the well-known "cauliflower *au gratin*." I have modified this (with improvement, I believe) by mashing the boiled marrow and stirring the grated cheese into the midst of it while as hot as possible; or, better still, by adding a little milk, a pinch of bicarbonate of potash, mixing with the cheese, and then returning this *purée* to the saucepan, heating and stirring it there for a few minutes to effect the complete solution of the cheese. This dish is not so pretty as that *au gratin* browned in orthodox fashion, but is more digestible.

### XLIII.—THE COOKERY OF WINE.

In an unguarded moment I promised to include the above in this series, and will do the best I can to fulfill the promise; but the utmost result of this effort can only be a contribution to the subject which is too profoundly mysterious to be fully grasped by any intellect that is not sufficiently clairvoyant to penetrate paving-stones and see through them to the interiors of the closely tiled cellars wherein the mysteries are manipulated.

I will first define what I mean by the cookery of wine. Grape-juice in its unfermented state may be described as "raw wine," or this name may be applied to the juice after fermentation. I apply it in the latter sense, and shall use it as describing grape-juice which has been spontaneously and recently fermented without the addition of any foreign materials, or altered by keeping, or heating, or any other process beyond fermentation. All such processes and admixtures which effect any chemical changes on the raw material I shall describe as cookery, and the result as cooked wine. When wine made from other juice than that of the grape is referred to it will be named specifically.

At the outset a fallacy, very prevalent in this country, should be controverted. The high prices charged for the cooked material sold to Englishmen has led to absurdly exaggerated notions of the original value of wine. I am quite safe in stating that the average market

value of rich wine in its raw state, in countries where the grape grows luxuriantly, and where, in consequence, the average quality of the wine is the best, does not exceed sixpence per gallon, or one penny per bottle. I speak now of the newly made wine. Allowing another sixpence per gallon for barreling and storage, the value of the commodity in portable form becomes twopence per bottle. I am not speaking of thin, poor wines, produced by a second or third pressing of the grapes, but of the best and richest quality, and, of course, I do not include the fancy wines, those produced in certain vineyards of celebrated châteaux, that are superstitiously venerated by those easily deluded people who suppose themselves to be connoisseurs of choice wines. I refer to the ninety-nine and nine tenths per cent of the *rich* wines that actually come into the market. Wines made from grapes grown in unfavorable climates naturally cost more in proportion to the poorness of the yield.

As some of my readers may be inclined to question this estimate of average cost, a few illustrative facts may be named. In Sicily and Calabria I usually paid, at the road-side or village "osterias," an equivalent to one halfpenny for a glass or tumbler holding nearly half a pint of common wine, thin, but genuine. This was at the rate of less than one shilling per gallon, or twopence per bottle, and included the cost of barreling, storage, and inn-keeper's profit on retailing. In the luxuriant wine-growing regions of Spain, a traveler, halting at a railway refreshment station and buying one of the sausage sandwiches that there prevail, is allowed to help himself to wine to drink on the spot without charge, but, if he fills his flask to carry away, he is subjected to an extra charge of one halfpenny. It is well known to all concerned that at vintage-time of fairly good seasons, in all countries where the grape grows freely, a good cask is worth more than the new wine it contains when filled; that much wine is wasted from lack of vessels, and anybody sending two good empty casks to a vigneron can have one of them filled in exchange for the other. Those who desire further illustrations and verification should ask their friends—*outside of the trade*—who have traveled in southern wine countries, and know the language and something more of the country than is to be learned by being simply transferred from one hotel to another under the guidance of couriers, cicerone, valets de place, and other flunkies. Wine-merchants are "men of business."

Thus the five shillings paid for a bottle of rich port is made up of one penny for the original wine, one penny more for cost of storage, etc., about sixpence for duty and carriage to this country, and twopence for bottling, making tenpence altogether; the remaining four shillings and twopence is paid for cookery and wine-merchant's profits.

Under cookery I include those changes which may be obtained by simply exposing the wine to the action of the temperature of an ordinary cellar, or the higher temperature of "Pasteuring," to be presently described.

In the youthful days of chemistry the first of these methods of cookery was the only one available, and wine was kept by wine-merchants with purely commercial intent for a considerable number of years.

A little reflection will show that this simple and original cookery was very expensive, sufficiently so to legitimately explain the rise in market value from tenpence to five shillings or more per bottle.

Wine-merchants require a respectable profit on the capital they invest in their business—say ten per cent per annum on the prime cost of the wine laid down. Then there is the rental of cellars and offices, the establishment expenses—such as wages, sampling, sending out, advertising, losses by bad debts, etc.—to be added. The capital lying dead in the cellar demands compound interest. At ten per cent the principal doubles in about seven and one third years. Calling it seven years, to allow very meagerly for establishment expenses, we get the following result:

| | | | £ | s. | d. | |
|---|---|---|---|---|---|---|
| When | 7 | years old the tenpenny wine is worth | 0 | 1 | 8 | per bottle. |
| " | 14 | " " " | 0 | 3 | 4 | " |
| " | 21 | " " " | 0 | 6 | 8 | " |
| " | 28 | " " " | 0 | 13 | 4 | " |
| " | 35 | " " " | 1 | 6 | 8 | " |

Here, then, we have a fair commercial explanation of the high prices of old-fashioned old wines; or of what I may *now* call the "traditional value" of wine.

Of course this is less when a man lays down his own wine in his own cellar in obedience to the maxim, "Lay down good port in the days of your youth, and when you are old your friends will not forsake you." He may be satisfied with a much smaller rate of interest than the man engaged in business fairly demands. Still, when wine thus aged was thrown into the market, it competed with commercially cellared wine, and obtained remarkable prices, especially as it has a special value for "blending" purposes, i. e., for mixing with newer wines and infecting them with its own senility.

But why do I say that *now* such values are traditional? Simply because the progress of chemistry has shown us how the changes resulting from years of cellarage may be effected by scientific cookery in a few hours or days. We are indebted to Pasteur for the most legitimate—I might say the only legitimate—method of doing this. The process is accordingly called "Pasteuring." It consists in simply heating the wine to the temperature of 60° C=140° Fahr., the temperature at which, as will be remembered, the visible changes in the cookery of animal food commences. It is a process demanding considerable skill; no portion of the wine during its cookery must be raised above this temperature, yet all must reach it; nor must it be exposed to the air.

The apparatus designed by Rossignol is one of the best suited for

this purpose. This is a large metallic vat or boiler with air-tight cover and a false bottom, from which rises a trumpet-shaped tube through the middle of the vat, and passing through an air-tight fitting in the cover. The chamber formed by the false bottom is filled with water by means of this tube, the object being to prevent the wine at the lower part from being heated directly by the fire which is below the water-chamber. A thermometer is also inserted air-tight in the lid, with its bulb half-way down the vat. To allow for expansion a tube is similarly fitted into the lid. This is bent siphon-like, and its lower end dipped into a flask containing wine or water, so that air or vapor may escape and bubble through, but none enter. Even in drawing off from the Pasteuring vat into the cask the wine is not allowed to flow through the air, but is conveyed by a pipe which bends down, and dips to the bottom of the barrel.

If heated with exposure to air, the wine acquires a flavor easily recognized as the "goût de cuit," or flavor of cooking. By Pasteur's method, properly carried out, the only changes are those which would be otherwise produced by age.

These changes are somewhat obscure. One effect is probably that which more decidedly occurs in the maturing of whisky and other spirits distilled from grain—viz., the reduction of the proportion of amylic alcohol or fusel-oil, which, although less abundantly produced in the fermentation of grape-juice than in grain or potato spirit, is formed in varying quantities. Caproic alcohol and caprylic alcohol are also produced by the fermentation of grape-juice or the "marc" of grapes, i. e., the mixture of the whole juice and the skins. These are acrid, ill-flavored spirits, more conducive to headache than the ethylic alcohol, which is proper spirit of good wine. Every wine-drinker knows that the amount of headache obtainable from a given quantity of wine, or a given outlay of cash, varies with the sample, and this variation appears to be due to these supplementary alcohols or ethers.

Another change appears to be the formation of ethers having choice flavors and bouquets; *œnanthic ether*, or the ether of wine, is the most important of these, and it is probably formed by the action of the natural acid salts of the wine upon its alcohol. Johnstone says: "So powerful is the odor of this substance, however, that few wines contain more than one forty-thousandth part of their bulk of it. Yet it is always present, can always be recognized by its smell, and is one of the general characteristics of all grape-wines." This ether is stated to be the basis of *Hungarian wine-oil*, which, according to the same authority, has been sold for flavoring brandy at the rate of sixty-nine dollars per pound. I am surprised that up to the present time it has not been cheaply produced in large quantities. Chemical problems that appear far more difficult have been practically solved.—*Knowledge.*

# THE ADVANTAGES OF LIMITED MUSEUMS.

By OSCAR W. COLLET.

BY a museum I do not mean a storehouse of things curious in art or nature—a repository of curiosities, as Worcester defines the word, although in most large towns there are places called museums, and realizing his definition—but a building in which are collected books, and natural or artificial objects that relate to, and are preserved, classified, and conveniently arranged to illustrate, one or more departments of knowledge, and from which objects of mere curiosity are excluded. Assuming that this description is sufficiently accurate and comprehensive for present purposes, it would seem that a museum should be regarded primarily as an instrument to communicate knowledge, and its growth subordinated to such instrumentality that the efficiency of the instrument may be assured. But the instrumentality is passive, not active, and consists in being a repository or source of knowledge for all that choose to avail themselves of it.

Knowledge really valuable, subjectively considered, is thorough; and therefore the instrument of its communication should be adapted and adequate to the purpose to which it is to be applied. Thorough knowledge is not a general acquaintance with everything, but knowing masterfully what one professes to know. If a museum is a storehouse from which knowledge is to be drawn, as knowledge is of many kinds, the repository should be so filled that nothing is wanting. But in most cases this is impossible. There is no reason, theoretically, forbidding an attempt to form a general museum which shall lack nothing necessary to its integrity, but practically failure is certain to result from the want of sufficient means. This difficulty is encountered the world over, and in part has led to the establishment of special museums—natural science, natural history, archæological museums, and the like.

This much premised, we now proceed to the subject of this paper, museums in the Western part of the United States. Respecting these museums we lay down two propositions: 1. They should be limited, not general museums; 2. That each one should select some specialty, and the more distinctly its boundary-lines are drawn the better, even if it be necessary, on the one side or the other, to run them somewhat arbitrarily as to inclusions and exclusions.

The value of every collection intended for scientific purposes and public use—books, natural science objects, ethnographical specimens, it matters not what—does not depend upon quantity or variety, but the completeness of its classes or their subdivisions. A reference library, for instance, that contained every publication of consequence relating to the Mississippi Valley, would be preferable to one more numerously

supplied with books on American history, but wanting many in every department; or an archæological cabinet able to show all that can be shown of the flint implements of the United States, but little else besides, is of a higher order than one in which there are more and varied specimens, but every class incomplete. What thoroughness is to the intellect, completeness is to a museum; one, an adequate knowledge of whatever the mind professes specially to occupy itself with, its parts and its relations; the other, the possession of all the types, sorts, and varieties in fullness, or books, that go to make up one or more classes. If this view is correct, its practical acceptance may be insisted upon; for, if incorporated into a museum undertaking, not as a theory but what should be realized, it would, by keeping before it a definite and fixed aim, steady and direct effort into proper channels of activity, and check hap-hazard collecting.

It is the part of prudence to aim not at what may be theoretically desirable or best, but at what is practicable. How feeble are the resources, present and prospective, of any Western museum actually existing or likely to be formed; how totally inadequate to extended work; how hopeless the prospect of their large increase! On the other hand, how numerous are the specimens in any one division of the objects of which a museum may be the repository; how considerable is the expense of bringing them together and of their preservation! An archæological or a natural history collection, with its building and equipments, moderately furnished with specimens, and including its library, would probably represent a money value of hundreds of thousands of dollars; were either supplied with all that it properly includes, its real value would be deemed fabulous. What hope is there in these Western countries that an institution which attempted to cover the whole field of archæology, or of natural history, would ever be much more than a very incomplete affair? And, if special museums are practically fettered by such limitations, how much more general museums! Therefore, it appears to me that no museum should attempt to be more than a limited museum.

Besides limiting the scope of a museum, whether it includes several of the classes of objects that may find a place in its collections or not, some subdivision of a class should be made a specialty; for, unless this be done, there is little likelihood of the museum ever possessing a department which will be complete. How immense, for instance, is the number of individual objects necessary to represent, by a single specimen, each of its kind, the animal kingdom, with its six sub-kingdoms, their subdivisions, classes, orders, species, and varieties, already known, from the dawn of animal life down to our own day, besides species and varieties yet to be discovered! It were useless to compute what the formation of a complete natural history collection involves. Under circumstances far more favorable than any Western museum is likely to find itself in within a century, three generations

would have passed, and such a collection still remain little more than a skeleton; whereas, a subdivision of a class, say flint implements of an archæological collection, to cite another illustration, is something manageable, but to bring even it to completeness is no small undertaking. Of course, there is a difference between one class and another, one subdivision and another, as regards the plentifulness or scarcity of material necessary to its formation, and the facility or difficulty with which it may be obtained; but I doubt whether a complete collection of the flint implements of North America could be made in twenty years, and, were an attempt made to include the flint implements of the world, it would be simply courting failure.

Possibly it may be thought that a museum governed by what is advocated in this paper must progress slowly, and at best long remain a meager and insignificant affair. If progress consists in extending in every direction, the objection is well taken; but, if in an orderly advance toward a fixed point, it is not. But let us see how things would work in practice. A library, of which books relating to the Mississippi Valley are the specialty, completive of its specialty, would find itself in possession of a pretty large collection treating of the history, geography, and legislative affairs of the United States and Canada, and of their aboriginal races, books of statistics and travel, biographies, compilations of documents, histories of the three most prominent countries of Europe, including treatises on their laws and colonial regulations, and numerous publications relating to their religious and ecclesiastical affairs. Again, works on archæology or natural history are an integral part of an archæological or natural history museum, and included in its specialty, no matter what the specialty may be. But to cite the first, as sufficient for our purposes, its books would comprise many thousand titles, beginning with the Bible, and including Homer, Herodotus, and others of the ancients, a multitude of historical books, books of travels, works relating to the aboriginal populations of the world, besides the untold number of publications directly treating archæological topics. In fact, I much doubt whether any one who has not set himself to the task of ascertaining just what an archæological library includes can have even a vague notion of its diversity or extent. As to variety of specimens we shall see presently that it would not be wanting.

But, in insisting that a museum to attain to real excellence should pursue some specialty, it is not intended to limit the choice to any class or subdivision, for circumstances will determine the selection, or to exclude everything else; or, still less, to make the completion of the specialty its ultimate goal, for of all works a museum contains the most vigorous germ of progress, and practically can never be finished; but that the specialty shall be paramount until filled out to the utmost possible. When this term is reached, another subdivision in turn is made the specialty. An instance already cited will serve further to

illustrate what is meant—an archæological museum that makes the flint implements of the United States its specialty. Its aim is to bring together every type, form, variety, and size of objects fashioned by flaking or chipping, of every material used, and in a general way from every locality in the country. But, as it is not possible practically to collect exclusively in one line, other objects will necessarily find their way into the museum at the same time. In exploring, or in acquiring at first hands, a variety of specimens is always obtained. An important source of increase are gifts, and gifts are taken as they come. It is a common thing to acquire collections already formed, and almost invariably they comprise a miscellaneous assortment. The same condition of things will exist, no matter to what objects the museum is devoted or what its specialty may be. Thus, the museum, however rigidly the specialty is kept paramount, in spite of the fact, will also increase in other subdivisions and classes.

What is done by rule and systematically is likely, in the long run, to be well done. But, in order to establish system and prescribe rule, it is requisite first to determine what can and what can not be done, and then what should be done for a reason apparently sufficient, having due regard to the limitations of circumstances and the necessities of the case. This has been my aim, and if I have failed to express myself with all the precision and clearness and fullness that could be desired, there is, nevertheless, I think, a strong, true meaning at bottom in what I have presented, that will approve itself to the thoughtful mind. This much I venture to insist upon, that whether what is advocated be accepted or not, it is, at least, a safe guide to orderly and systematic progress, and to completeness in one or more classes or subdivisions of a museum.

## THE ARCHITECTURE OF TOWN-HOUSES.

By ROBERT W. EDIS, F. S. A.

IN choosing as my subject "The Building of Town-Houses," it seemed to me that I might, from the experience gained during the past five-and-twenty years in my professional career as an architect, give some information and suggestions on the various points which should be specially observed and insisted upon in any building wherein sound construction, healthy arrangement, common-sense treatment of the rooms, and practical knowledge in their general fitting up, are all-important, where health, cleanliness, and comfort, and economy of service and labor, are considered necessary.

The speculative builders have too long had their way without control of any kind, save that which is provided for under the Metropolitan Building and other local acts, which simply permit of the dis-

trict surveyors insisting upon certain thicknesses of walls, but give them no power to reject inferior materials, or to prevent scamping and unsound work, and the disregard of all known sanitary laws, and of the commonest precautions to insure health and comfort.

It is surely time that every house erected in the great centers of habitation should have some systematic supervision, so that ordinary precautions shall be insisted upon to secure proper sanitation, to prevent the use of grossly inferior materials, and to prevent these plague-spots being formed in our midst; for it must be borne in mind that every house built under the system I have condemned not only tends to the individual discomfort of the special occupier, but adds materially to the unhealthiness of a neighborhood.

In the building of new and the rebuilding of old houses, it is essential that proper regard shall be had to the rapid growth of sanitary science, and not only to comply with, but "anticipate as far as possible, its many requirements, and especially those of them which will, I believe, in a few years be considered by the population at large as absolutely necessary for habitable dwellings, not only as regards the actual sanitary fittings and appliances of the houses themselves, but also as regards their actual construction from the foundation upward, and also more especially as regards the light and air spaces with which they are surrounded."

If our towns are to be reconstructed and added to on healthy and proper principles, each house must be properly constructed, and certain fixed rules insisted upon, as regards proper general health arrangement and sanitation; for "the same rule," to quote Dr. Richardson, "applies to accumulation of health as to the accumulation of wealth." "Take care of the pennies," says the financier, "the pounds will take care of themselves." "Take care of the houses," says the sanitarian, "the towns will take care of themselves." It follows, therefore, that so far as common-sense laws can be applied to the rebuilding of the houses of closely packed communities, they should be on some general and uniform system, so far as laws of health are concerned, which all must follow. But this only applies to sanitation; so far as general arrangement is concerned, the wants of the individual must necessarily be consulted; and, so far as the artistic improvement of our towns is concerned, I am strongly of opinion that the greater the variety of designs, the greater will be the artistic character and general picturesqueness of our streets.

To sacrifice internal comfort, light, and ventilation to some special order of fenestration, Greek, Roman, or Italian, or to the cramped and narrow lines of a mediæval fortress or building of by-gone ages, seems to me to convey nothing but poverty of thought, or narrow-minded conventionalism, as opposed to all true principles of architecture as it is to the wants and requirements of the people of the nineteenth century.

Comfort and convenience of arrangement, ample light and ventilation everywhere; protection from damp and miasma, impure and unhealthy smells; warmth, freedom from draught; pure air, pure water, general cleanliness, and attention to all laws of sanitation, are first of all to be considered in every house. The architect or artist can so fashion the external clothing of a good framework as to make it agreeable in its outline and general constructive decoration; but the elevation should be subservient to the plan and constructional requirements necessary to provide all these desiderata, and should not be made the paramount feature in the design of a new house, or in the rebuilding of an old one.

I have lately been reading a powerfully written article by Dr. Richardson, in which he sets forth, in vigorous but not exaggerated language, the various communicable diseases which are "promoted or introduced by the errors of construction in the dwellings of our communities"; and I have been much struck by the number of preventable ills which he associates with bad ventilation, damp, bad drainage, impure water-supplies, want of light and through draught, uncleanliness and foulness, or stuffiness of modern dwellings; and I hope you will permit me briefly to refer to and quote some of his remarks.

To begin with, typhus, typhoid, relapsing and scarlet fevers, are mainly due to foul air, impure smell, or water, or closely packed and unventilated rooms, while the poisons thrown off by these diseases are retained in the walls and flooring, if badly constructed; while impure air arising from dust and dirt accumulations, and bad sanitation, tend to other illnesses in a minor degree, such as dyspepsia, nervousness, and depression, "during the presence of which conditions" (to quote Dr. Richardson) "a person is neither well nor ill." Another of our worst English diseases, "pulmonary consumption, or consumption of the lungs, has been largely promoted by the presence of unchanged and impure air in the dwelling-house," while "neuralgic and miasmatic diseases" are brought about by the same causes, assisted by atmospheric moisture or damp, so often to be found in houses built either upon clay or in moist situations, where the ordinary precautions of covering the whole surface area with concrete or some other damp preventive has not been carried out.

Dampness is more or less directly the cause of all the malarious diseases—ague, neuralgia, and rheumatism—and here the speculative builder comes in, with venom certain and incurable, with soft, spongy bricks which absorb a large amount of water, with mortar composed of road drift or scrapings, foul and unhealthy; with damp and unseasoned timber, ingredients in the plague-spots which warmth of fires bring out in vapor, and wherein moisture seems ever present, dimming the mirrors or condensing on painted walls, or absorbed in paper or distemper, which, on every damp day, becomes a visible barometer, marking plainly the change of temperature.

In badly-constructed and ill-arranged houses, how often do we hear the inhabitants complain of what is technically called "draught," which means sudden and irregular change of temperature! Unpleasant as it is in itself, it is most insidious and dangerous in its results, bringing about colds, chills, and general "disturbance in the circulation of the organs of the body."

It is unnecessary to dwell further upon the numerous ills which we have it in our power to lessen, or altogether get rid of, by attention to the general construction of the houses we live in. I can only insist generally, with Dr. Richardson, that "the intention and object of domestic sanitation is so to construct houses for human beings, or, if the houses be constructed, so to improve them, that the various diseases and ailments incident to bad construction may be removed to the fullest possible extent. The diseases need not be looked upon as necessities of existence, but may be recognized as results of ignorance, or as accidents which, though they may not spring from sheer and wanton ignorance, are removable by accurate foreseeing and all-providing knowledge."

In towns, where, for the most part, all houses are built in groups, either in streets, terraces, or squares, and rarely detached, the general aspect is naturally fixed by the location of the building, and the laying out of the street or terrace of which the particular house already forms or is to form a part; and, therefore, it is of the utmost importance as far as possible to secure as much light and sun as can be obtained by the slightly varied aspect which is given by semi-octagonal or circular-projecting windows with side-lights, more especially where the plotting of the site lies more or less due north and south.

Nothing can be more miserable and unartistic, nothing more insulting to good taste, than the dreary monotony and vulgarity of most London streets, old and new. How much more artistic and picturesque could our streets be made if broken up with bays and gables, cutting up the sky-line, like the streets in many of the old towns in Germany and Belgium; and how much more cheerful and healthy would be the rooms wherein these bays are thrown out, and through which sun, air, and light can be obtained in more ample quantity, than by means of the two or three parallelogram-shaped openings which generally form the windows in most London fronts! Anyway, there is an old adage, which is more or less true, that, "where the sun does not enter, sickness in some sort or way is sure to obtain." We do not get too much sun in smoke-covered towns; and surely every possible allowance, consistent of course with what is due to the comfort and enjoyment of our neighbors, should be made for flat-sided projections, by which more sun and light can be given to our homes.

Fancy being on the south side of a street, where the windows face due north, and into which, for nearly the whole of the year, the sun can never shine, save very occasionally in thin, slantwise streaks. Were

it not for the generally disagreeable views that are obtainable from the backs of town-houses, I should be often inclined to advise that all the best rooms in such a case should be placed at the back, with projecting bays, and so to obtain, as far as is practicable, some glimpse and use of the sun during all hours of the day.

Why, too, can not the backs of our houses be made more decent, if only by means of glazed bricks varied occasionally with bands of color? When we see the backs of some of the grand, stucco-covered palaces of our western suburbs, we are apt to think of the old rhyme which, written on some piece of modern church or chapel architecture, says that—

> "They built the front, upon my word,
> As fine as any abbey;
> And, thinking they might cheat the Lord,
> They made the back part shabby."

Of course, I know glazed bricks are more expensive than the common stocks, but the extra expense would be amply repaid by the extra light and better air, for the glaze naturally makes the brick not absorbent, and every shower of rain would wash the walls, so faced, clean.

Why should we not have every new house in such places as Berkeley or Grosvenor Squares built with projecting oriels and bays, and high-pitched gables? The gables would add materially to the light and comfort—not to say anything of the artistic character—of the rooms, while the latter would surely be preferable to the generally miserable so-called dormers, which are, as a rule, set back behind the balconies or parapets, in the attics of most town-houses; these, I am told often, are quite good enough for servants, a selfish, cruel, if not a suicidal opinion; for, if we are to have servants in health, and fitted to carry out their daily occupations, with comfort to themselves and justice to their employers, their rooms should be just as light, airy, and cheerful as any others in the house. Let the sun call them in the morning if you can, and give a greeting in a light, cheery manner to the commencement of their daily labor. In addition to the manifest improvement to the elevation and rooms of the house, all these irregularities tend to promote movement in the air, to give light and shade, and thus to help toward health in the building, and pleasure in our walks abroad.

In speaking upon the next part of my subject, that of design, I desire to recognize and appreciate, in the largest possible sense, the varieties of taste which must necessarily prevail in an age where, as a rule, precedent and fashion are all-predominant; but I do insist that the external design, properly considered, that is, the general elevation of the street front, should and must be subservient to the internal requirements; and that the light, air, ventilation, and common-sense requirements of the house must in no way be sacrificed to the external

design, for no beauty of mere architectural effect will compensate for discomfort and bad internal arrangement.

A good plan will make a good elevation; but an elevation in which specific rules which might be fitting for a Greek temple or a mediæval fortress are insisted on, is in no way suitable to an ordinary house, in which the first essentials are lofty and well-arranged windows, and proper light and air space.

Gothic tracery and pointed openings are not suited to ordinary sash-windows, and it surely is inconsistent with modern street design to attempt anything in which one or other of the so-called five orders of classic architecture has to be worked into a house in which the frontage is perhaps eighteen or twenty feet at most. When it was attempted in the beginning of this century, in the terraces of Regent's Park, generally two or more houses were embraced in the design, a manifest inconvenience and absurdity when one owner wants to paint his front red and the other yellow.

The fashion of the day is running into modern Dutch, or so-called Queen Anne, and inasmuch as this style admits of ample fenestration, and does not limit the size of light-openings, and relies for its piquancy and character on honest red brick instead of sham plaster and vulgar imitation, we may be thankful for small mercies, and be content with a revival of a sixteenth and seventeenth century Renaissance school of architecture, which gives us at least color and picturesqueness in our London streets.

I go so far as to say that the man who builds a red-brick house in a town, where want of color tends to make everything glaring or, where smoke-covered, gloomy, is a benefactor to his species; and I go still further in saying that to a great extent the materials used should, in a manner, be those which are peculiar to the country and locality. Stone of various kinds is indigenous to certain localities, and naturally suggests itself to the particular neighborhoods.

We have plenty of good brick clay; we can obtain readily first-class red bricks and terra-cotta, and both these materials are more lasting and more suitable to London smoke and the deleterious action of London atmosphere than almost any stone which exists.

Glazed and colored brick, and faïence, and terra-cotta, admit of almost any variety of design; they give picturesqueness, warmth, and color where they are wanted.

I should like to see London streets made picturesque and beautiful in color, with terra-cotta and glazed faïence, which every shower of rain would cleanse and improve, and should like to see every stucco-fronted building decaying and unlet. As a rule, this sort of work is not only imitation of stone, bad in taste, bad in construction, and unfit to last any time, but glosses over inferior building, and covers a multitude of sins which it would be well for the occupiers, from a mere common-sense and sanitary point of view, to lay bare.

We do not want pseudo-Italian palaces, or bad copies of French street architecture, with forced arrangement of fenestration and cutting up of wall-space, utterly at variance with home requirements; nor do we want so-called mediæval structures, in which light, ventilation, and air are sacrificed to narrow Gothic or pointed-headed windows and doorways.

So far as I can judge, it seems to me that the so-called Elizabethan, or later Renaissance, of this country is infinitely more charming and more suitable to every-day wants and requirements than any other style, Greek, Roman, or Gothic; anyway, we want to express in our external work a sense of comfort and utility, and to provide ample light and air-space for the rooms, of which the front wall is only the external casing; and any style which combines these desiderata will commend itself to common-sense people.

Good architectural effect may be perfectly well obtainable with a good common-sense plan, and there is no possible excuse for a design, whether classic, Gothic, or Queen Anne, which does not first of all recognize the internal necessities and conveniences, and which is not subordinate to a great extent to every-day internal requirements of a well-arranged and comfortable house. While I advocate first of all that the elevation or design should be made subservient to the plan, I do not see the necessity of following the types of various schools of French, Italian, or thirteenth, fourteenth, or fifteenth century Gothic buildings; and, when I see the pretentiousness of imitation of either of these schools, I am bound to confess that it suggests nothing but an ignorant conceit, which would not for a moment have been carried out by the great architects, whose works we admire, had they had all the modern improvements which increased knowledge and higher skill in invention have brought about.

In our monumental buildings, and even in our ordinary street fronts, architecture should be much more intimately allied with the sister arts of sculpture and painting. Even a porch in which the ornament is modeled with care by an artist, or the corbel of a projecting bay, will redeem an otherwise bad design from commonplaceness; a proper regard for proportion and arrangement of outline in the most simple building shows the work of a true artist, much more than the overlaying of his work with useless ornament or carving, or the overcrowding of parts with feeble enrichment stuck on balustrading and pediments. In house-design, it seems to me that, first of all, the design should convey some expression of the comfort and general planning of the building, and that its fenestration should show, above all, proper regard to the lighting and ventilation of the rooms, and generally bear the characteristics of the material with which it is carried out.

If importance is wanted in an elevation, let it be got by good sculpture in such portions of the building as are nearest the eye-line; a porch properly treated with good modeled decoration, either in figure

or relief ornament, can be made as imposing as you like, while balcony-fronts can be of good wrought-iron, like some of those in the old picturesque towns of Spain and Germany, instead of lumpy and heavy with balustrading, which not only shuts out light from the rooms, but suggests an element of danger by their utterly false and generally insufficient construction; but I confess to a feeling of astonishment when I see friezes and cornices of buildings in narrow streets, some forty or fifty feet from the street-level, covered with elaborate carving and enrichment which it is impossible even to look at without craning the neck, and which can only be appreciated by the servants who inhabit the attics over the way. There is no possible reason why street frontages should not be made picturesque and beautiful instead of tame and ugly, and the commonest of fronts can often be redeemed by some good bit of detail and decoration in the shape of red brick, terra-cotta, or glazed faïence. Picturesque fronts, with projecting oriels or bays and gabled roofs, need cost no more than some of these wretched travesties of Italian or French architecture, with so-called Mansard-roofs and cramped dormer lights, and would give grace and charm, and color, where now commonplaceness, vulgarity, and bad taste reign supreme.

Too often the first principles of proportion are lost sight of, owing to the want of proper culture of the eye, and details which might be well suited to a Genoese or Roman palace are stuck on to a narrow street frontage.

There is no need why London street architecture should not embody every modern improvement, and be carried out in a common-sense and picturesque style, suitable for every-day wants, and in conformity with all the various scientific principles of sanitation which the nineteenth century has produced, "instead of resuscitating old forms and old features, which our forefathers would have gladly changed" had they had the knowledge or benefit of modern improvements. I have no desire to see any one uniform style of building, but, whatever style is taken up by the individual owner, it is first of all essential that it should be made to adapt itself to the internal requirements, and that there be ample light, and common-sense treatment of the window-spaces, so that they be arranged in the rooms in proper places, and not thrust into corners, or raised so high from the floors as to be prison-like, to suit the external design; and whether Greek, Italian, Queen Anne, or any date or period of so-called Gothic art, it must be governed by present wants, and possess every sanitary and modern invention which may make the individual house more comfortable, more healthy, and more convenient for the purposes for which it is required.

Renaissance, whether German, Italian, or French, freely or simply treated, and all the later phases of the Jacobean and English Elizabethan periods, are capable of being successfully adapted to present home-life and modern requirements.

So far as my experience goes, the public generally are unaware of the real advantages and merits of terra-cotta for facing street fronts. When properly burned, it is absolutely impervious to smoke, and is unaffected by acid fumes of any description; it is about half the weight of the lightest building-stones, and its resistance, when burned in solid blocks in compression, is nearly one third greater than that of Portland stone; it is not absorbent—a great desideratum when damp has to be considered—it is easily molded into any shape, for strings, cornices, or window-sills and architraves, and can be easily modeled for figure or other enrichment. It can be got in good warm yellow or red color, and, when glazed, can be produced in almost any tones of soft browns, greens, reds, or yellows; and its strength, durability, and imperviousness to all the destructive influences of town atmospheres, to my mind, recommend it as the building material most adapted for facing street frontages.

Let me say a few words about iron railings. To what disastrous order of things we owe the prison-like bars and straight lines of the ordinary front railings in our streets, I am at a loss to understand; but surely nothing can be more hideous or more unartistic. Why cannot we redeem the general want of taste in London streets by something like good design in balcony-fronts or area-railings? They may be made just as secure, and just as useful, if made ornamental in form, like the beautiful iron-work of the old towns in Spain, Italy, and Germany, which can be seen in the humblest street front as well as in the princely palaces; or like the English work of the last century, some few specimens of which remain.

It is in these small matters that the taste of a people is shown, and it is by these minor features of design in the necessities of street architecture that picturesqueness and grace are to be obtained.

Let me close this lecture by a quotation from one delivered over a quarter of a century ago, by a writer who was then one of the greatest of living word-painters:

"If you build well and artistically, you will talk to all who pass by, and all those little sympathies, those freaks of fancy, those jests in stone, those workings out of problems in caprice, will occupy mind after mind of utterly countless multitudes, long after you are gone. You have not, like authors, to plead for a hearing, or to fear oblivion. Do but build large enough and boldly enough, and all the world will hear you; they can not choose but look."—*Abridged from the Journal of the Society of Arts.*

## MOUNTAIN OBSERVATORIES.

ON October 1, 1876, one of the millionaires of the New World died at San Francisco. Although owning a no more euphonions name than James Lick, he had contrived to secure a future for it. He had founded and endowed the first great astronomical establishment planted on the heights, between the stars and the sea. How he came by his love of science we have no means of knowing. Born obscurely at Fredericksburg, in Pennsylvania, August 25, 1796, he amassed some thirty thousand dollars by commerce in South America, and in 1847 transferred them and himself to a village which had just exchanged its name of Yerba Buena for that of San Francisco, situate on a long, sandy strip of land between the Pacific and a great bay. In the hillocks and gullies of that wind-blown barrier he invested his dollars, and never did virgin-soil yield a richer harvest. The gold-fever broke out in the spring of 1848. The unremembered cluster of wooden houses, with no trouble or tumult of population in their midst, nestling round a tranquil creek under a climate which, but for a touch of sea-fog, might rival that of the Garden of the Hesperides, became all at once a center of attraction to the outcast and adventurous from every part of the world. Wealth poured in; trade sprang up; a population of six hundred increased to a quarter of a million; hotels, villas, public edifices, places of business spread, mile after mile, along the bay; building-ground rose to a fabulous price, and James Lick found himself one of the richest men in the United States.

Thus he got his money; we have now to see how he spent it. Already the munificent benefactor of the learned institutions of California, he in 1874 formally set aside a sum of two million dollars for various public purposes, philanthropic, patriotic, and scientific. Of these two millions, seven hundred thousand were appropriated to the erection of a telescope "superior to and more powerful than any ever yet made." But this, he felt instinctively, was not enough. Even in astronomy, although most likely unable to distinguish the pole-star from the dog-star, this "pioneer citizen" could read the signs of the times. It was no longer instruments that were wanted; it was the opportunity of employing them. Telescopes of vast power and exquisite perfection had ceased to be a rarity; but their use seemed all but hopelessly impeded by the very conditions of existence on the surface of the earth.

The air we breathe is in truth the worst enemy of the astronomer's observations. It is their enemy in two ways. Part of the light which brings its wonderful, evanescent messages across inconceivable depths of space, it stops; and, what it does not stop, it shatters. And this even when it is most transparent and seemingly still; when mist-veils are withdrawn, and no clouds curtain the sky. Moreover, the evil

grows with the power of the instrument. Atmospheric troubles are magnified neither more nor less than the objects viewed across them. Thus, Lord Rosse's giant reflector possesses—*nominally*—a magnifying power of 6,000; that is to say, it can reduce the *apparent* distances of the heavenly bodies to $\frac{1}{6000}$ their *actual* amount. The moon, for example, which is in reality separated from the earth's surface by an interval of about two hundred and thirty-four thousand miles, is shown as if removed only thirty-nine miles. Unfortunately, however, in theory only. Professor Newcomb compares the sight obtained under such circumstances to a glimpse through several yards of running water, and doubts whether our satellite has ever been seen to such advantage as it would be if brought—substantially, not merely optically—within five hundred miles of the unassisted eye.*

Must, then, all the glowing triumphs of the optician's skill be counteracted by this plague of moving air? Can nothing be done to get rid of, or render it less obnoxious? Or is this an ultimate barrier, set up by Nature herself, to stop the way of astronomical progress? Much depends upon the answer—more than can, in a few words, be easily made to appear; but there is fortunately reason to believe that it will, on the whole, prove favorable to human ingenuity, and the rapid advance of human knowledge on the noblest subject with which it is or ever can be conversant.

The one obvious way of meeting atmospheric impediments is to leave part of the impeding atmosphere behind; and this the rugged shell of our planet offers ample means of doing. Whether the advantages derived from increased altitudes will outweigh the practical difficulties attending such a system of observation when conducted on a great scale, has yet to be decided. The experiment, however, is now about to be tried simultaneously in several parts of the globe.

By far the most considerable of these experiments is that of the "Lick Observatory." Its founder was from the first determined that the powers of his great telescope should, as little as possible, be fettered by the hostility of the elements. The choice of its local habitation was, accordingly, a matter of grave deliberation to him for some time previous to his death. Although close upon his eightieth year, he himself spent a night upon the summit of Mount St. Helena, with a view to testing its astronomical capabilities, and a site already secured in the Sierra Nevada was abandoned on the ground of climatic disqualifications. Finally, one of the culminating peaks of the Coast Range, elevated 4,440 feet above the sea, was fixed upon. Situated about fifty miles southeast of San Francisco, Mount Hamilton lies far enough inland to escape the sea-fog, which only on the rarest occasions drifts upward to its triple crest. All through the summer the sky above it is limpid and cloudless; and, though winter storms are frequent, their raging is not without highly available lucid intervals. As

* "Popular Astronomy," p. 145.

to the essential point—the quality of telescopic vision—the testimony of Mr. S. W. Burnham is in the highest degree encouraging. This well-known observer spent two months on the mountain in the autumn of 1879, and concluded, as the result of his experience during that time —with the full concurrence of Professor Newcomb—that "it is the finest observing location in the United States." Out of sixty nights he found forty-two as nearly perfect as nights can well be, seven of medium quality, and only eleven cloudy or foggy;* his stay, nevertheless, embraced the first half of October, by no means considered to belong to the choice part of the season. Nor was his trip barren of discovery. A list of forty-two new double stars gave an earnest of what may be expected from systematic work in such an unrivaled situation. Most of these are objects which never rise high enough in the sky to be examined with any profit through the grosser atmosphere of the plains east of the Rocky Mountains; some are well-known stars, not before seen clearly enough for the discernment of their composite character; yet Mr. Burnham used the lesser of two telescopes—a 6-inch and an 18-inch achromatic—with which he had been accustomed to observe at Chicago.

The largest refracting telescope as yet actually completed has a light-gathering surface twenty-seven inches in diameter. This is the great Vienna equatorial, admirably turned out by Mr. Grubb, of Dublin, in 1880, but still awaiting the commencement of its exploring career. It will, however, soon be surpassed by the Pulkowa telescope, ordered more than four years ago on behalf of the Russian Government from Alvan Clark & Sons, of Cambridgeport, Massachusetts. Still further will it be surpassed by the coming "Lick Refractor." It is safe to predict that the optical championship of the world is, at least for the next few years, secured to this gigantic instrument, the completion of which may be looked for in the immediate future. It will have a clear aperture of *three feet*. A disk of flint-glass for the object-lens, 38·18 inches across, and one hundred and seventy kilogrammes in weight, was cast at the establishment of M. Feil, in Paris, early in 1882. Four days were spent and eight tons of coal consumed in the casting of this vast mass of flawless crystal; it took a calendar month to cool, and cost two thousand pounds sterling.† It may be regarded as the highest triumph so far achieved in the art of optical glass-making.

A refracting telescope three feet in aperture collects rather more light than a speculum of four feet.‡ In this quality, then, the Lick

* "The Observatory," No. 43, p. 613.

† "Nature," vol. xxv, p. 537.

‡ Silvered glass is considerably more reflective than speculum-metal, and Mr. Common's 36-inch mirror can be but slightly inferior in luminous capacity to the Lick objective. It is, however, devoted almost exclusively to celestial photography, in which it has done splendid service. The Paris 4-foot mirror bent under its own weight when placed in the tube in 1875, and has not since been remounted.

instrument will have—besides the Rosse leviathan, which, for many reasons, may be considered to be out of the running—but one rival. And over this rival—the 48-inch reflector of the Melbourne Observatory—it will have all the advantages of agility and robustness (so to speak) which its system of construction affords; while the exquisite definition for which Alvan Clark is famous will, presumably, not be absent.

Already preparations are being made for its reception at Mount Hamilton. The scabrous summit of "Observatory Peak" has been smoothed down to a suitable equality of surface by the removal of 40,000 tons of hard trap-rock. Preliminary operations for the erection of a dome, seventy-five feet in diameter, to serve as its shelter, are in progress. The water-supply has been provided for by the excavation of great cisterns. Buildings are being rapidly pushed forward from designs prepared by Professors Holden and Newcomb. Most of the subsidiary instruments have for some time been in their places, constituting in themselves an equipment of no mean order. With their aid Professor Holden and Mr. Burnham observed the transit of Mercury of November 7, 1881, and Professor Todd obtained, December 6, 1882, a series of 147 photographs (of which seventy-one were of the highest excellence) recording the progress of Venus across the face of the sun.

We are informed that a great hotel will eventually add the inducement of material well-being to those of astronomical interest and enchanting scenery. No more delightful summer resort can well be imagined. The road to the summit, of which the construction formed the subject of a species of treaty between Mr. Lick and the county of Santa Clara in 1875, traverses from San José a distance, as a bird flies, of less than thirteen miles, but doubled by the windings necessary in order to secure moderate gradients. So successfully has this been accomplished, that a horse drawing a light wagon can reach the observatory buildings without breaking his trot.* As the ascending track draws its coils closer and closer round the mountain, the view becomes at every turn more varied and more extensive. On one side the tumultuous Coast Ranges, stooping gradually to the shore, magnificently clad with forests of pine and red cedar; the island-studded bay of San Francisco, and farther south, a shining glimpse of the Pacific; on the other, the thronging pinnacles of the Sierras—granite needles, lava-topped bastions—fire-rent, water-worn; right underneath, the rich valleys of Santa Clara and San Joaquin, and 175 miles away to the north (when the sapphire of the sky is purest), the snowy cone of Mount Shasta.

Thus, there seems some reason to apprehend that Mount Hamilton, with its monster telescope, may become one of the show-places of the New World. *Absit omen!* Such a desecration would effectually mar one of the fairest prospects opened in our time before astronomy. The

* E. Holden, "The Lick Observatory," "Nature," vol. xxv, p. 298.

true votaries of Urania will then be driven to seek sanctuary in some less accessible and less inviting spot. Indeed, the present needs of science are by no means met by an elevation above the sea of four thousand and odd feet, even under the most translucent sky in the world. Already observing stations are recommended at four times that altitude, and the ambition of the new species of climbing astronomer seems unlikely to be satisfied until he can no longer find wherewith to fill his lungs (for even an astronomer must breathe), or whereon to plant his instruments.

This ambition is no casual caprice. It has grown out of the growing exigencies of celestial observation.

From the time that Lord Rosse's great reflector was pointed to the sky in February, 1845, it began to be distinctly felt that instrumental power had outrun its opportunities. To the sounding of further depths of space it came to be understood that Atlantic mists and tremulous light formed an obstacle far more serious than any mere optical or mechanical difficulties. The late Mr. Lassell was the first to act on this new idea. Toward the close of 1852 he transported his beautiful 24-inch Newtonian to Malta, and, in 1859–'60, constructed, for service there, one of four times its light-capacity. Yet the chief results of several years' continuous observation under rarely favorable conditions were, in his own words, "rather negative than positive."* He dispelled the "ghosts" of four Uranian moons which had, by glimpses, haunted the usually unerring vision of the elder Herschel, and showed that our acquaintance with the satellite families of Saturn, Uranus, and Neptune must, for the present at any rate, be regarded as complete; but the discoveries by which his name is chiefly remembered were made in the murky air of Lancashire.

The celebrated expedition to the Peak of Teneriffe, carried out in the summer of 1856 by the present Astronomer Royal for Scotland, was an experiment made with the express object of ascertaining "how much astronomical observation can be benefited by eliminating the lower third or fourth part of the atmosphere."† So striking were the advantages of which it seemed to hold out the promise, that we count with surprise the many years suffered to elapse before any adequate attempt was made to realize them.‡ Professor Piazzi Smyth made his principal station at Guajara, 8,903 feet above the sea, close to the rim of the ancient crater from which the actual peak rises to a further height of more than 3,000 feet. There he found that his equatorial (five feet in focal length) showed stars fainter by *four magnitudes* than at Edinburgh. On the Calton Hill the companion of Alpha Lyræ (eleventh magnitude) could never, under any circumstances, be

* "Monthly Notices," Royal Astronomical Society, vol. xiv, p. 133, 1854.

† "Philosophical Transactions," vol. cxlviii, p. 465.

‡ Captain Jacob unfortunately died August 16, 1862, when about to assume the direction of a hill observatory at Poonah.

made out. At Guajara it was an easy object twenty-five degrees from the zenith; and stars of the fourteenth magnitude were discernible. Now, according to the usual estimate, a step downward from one magnitude to another means a decrease of luster in the proportion of two to five. A star of the fourteenth order of brightness sends us accordingly only one thirty-ninth as much light as an average one of the tenth order. So that, in Professor Smyth's judgment, the grasp of his instrument was virtually *multiplied thirty-nine times* by getting rid of the lowest quarter of the atmosphere.* In other words (since light falls off in intensity as the square of the distance of its source increases), the range of vision was more than sextupled, further depths of space being penetrated to an extent probably to be measured by thousands of billions of miles!

This vast augmentation of telescopic compass was due as much to the increased tranquillity as to the increased transparency of the air. The stars hardly seemed to twinkle at all. Their rays, instead of being broken and scattered by continual changes of refractive power in the atmospheric layers through which their path lay, traveled with relatively little disturbance, and thus produced a far more vivid and concentrated impression upon the eye. Their images in the telescope, with a magnifying power of one hundred and fifty, showed no longer the "amorphous figures" seen at Edinburgh, but such minute, sharply-defined disks as gladden the eyes of an astronomer, and seem, in Professor Smyth's phrase, to "provoke" (as the "cocked-hat" appearance surely baffles) "the application of a wire-micrometer" for purposes of measurement.†

The luster of the milky way and zodiacal light at this elevated station was indescribable, and Jupiter shone with extraordinary splendor. Nevertheless, not even the most fugitive glimpse of any of his satellites was to be had without optical aid.‡ This was possibly attributable to the prevalent "dust-haze," which must have caused a diffusion of light in the neighborhood of the planet more than sufficient to blot from sight such faint objects. The same cause completely neutralized the darkening of the sky usually attendant upon ascents into the more ethereal regions, and surrounded the sun with an intense glare of reflected light. For reasons presently to be explained, this circumstance alone would render the Peak of Teneriffe wholly unfit to be the site of a modern observatory.

* The height of the mercury at Guajara is 21·7 to 22 inches.

† "Philosophical Transactions," vol. cxlviii, p. 477.

‡ We are told that three American observers in the Rocky Mountains, belonging to the Eclipse Expedition of 1878, easily saw Jupiter's satellites night after night with the naked eye. That their discernment is possible even under comparatively disadvantageous circumstances is rendered certain by the well-authenticated instance (related by Humboldt, "Cosmos," vol. iii, p. 66, Otte's translation) of a tailor named Schön, who died at Breslau in 1837. This man habitually perceived the first and third, but never could see the second or fourth, Jovian moons.

Within the last thirty years a remarkable change, long in preparation,* has conspicuously affected the methods and aims of astronomy; or, rather, beside the old astronomy—the astronomy of Laplace, of Bessel, of Airy, Adams, and Leverrier—has grown up a younger science, vigorous, inspiring, seductive, revolutionary, walking with hurried or halting footsteps along paths far removed from the staid courses of its predecessor. This new science concerns itself with the *nature* of the heavenly bodies; the elder regarded exclusively their *movements*. The aim of the one is *description*, of the other *prediction*. The younger science inquires what sun, moon, stars, and nebulæ are made of, what stores of heat they possess, what changes are in progress within their substance, what vicissitudes they have undergone or are likely to undergo. The elder has attained its object when the theory of celestial motions shows no discrepancy with fact—when the calculus can be brought to agree perfectly with the telescope—when the coursers of the heavens come strictly up to time, and their observed places square to a hair's breadth with their predicted places.

It is evident that very different modes of investigation must be employed to further such different objects; in fact, the invention of novel modes of investigation has had a prime share in bringing about the change in question. Geometrical astronomy, or the astronomy of position, seeks above all to measure with exactness, and is thus more fundamentally interested in the accurate division and accurate centering of circles than in the development of optical appliances. Descriptive astronomy, on the other hand, seeks as the first condition of its existence to *see* clearly and fully. It has no "method of least squares" for making the best of bad observations—no process for eliminating errors by their multiplication in opposite directions; it is wholly dependent for its data on the quantity and quality of the rays focused by its telescopes, sifted by its spectroscopes, or printed in its photographic cameras. Therefore, the loss and disturbance suffered by those rays in traversing our atmosphere constitute an obstacle to progress far more serious now than when the exact determination of places was the primary and all-important task of an astronomical observer. This obstacle, which no ingenuity can avail to remove, may be reduced to less formidable dimensions. It may be diminished or partially evaded by anticipating the most detrimental part of the atmospheric transit—by carrying our instruments upward into a finer air—by meeting the light upon the mountains.

The study of the sun's composition, and of the nature of the stupendous processes by which his ample outflow of light and heat is kept up and diffused through surrounding space, has in our time separated,

* Sir W. Herschel's great undertakings, Bessel remarks ("Populäre Vorlesungen," p. 15), "were directed rather toward a physical description of the heavens than to astronomy proper."

it might be said, into a science apart. Its pursuit is, at any rate, far too arduous to be conducted with less than a man's whole energies; while the questions which it has addressed itself to answer are the fundamental problems of the new physical astronomy. There is, however, but one opinion as to the expediency of carrying on solar investigations at greater altitudes than have hitherto been more than temporarily available.

The spectroscope and the camera are now the chief engines of solar research. Mere telescopic observation, though always an indispensable adjunct, may be considered to have sunk into a secondary position. But the spectroscope and the camera, still more than the telescope, lie at the mercy of atmospheric vapors and undulations. The late Professor Henry Draper, of New York, an adept in the art of celestial photography, stated in 1877 that two years, during which he had photographed the moon at his observatory on the Hudson on every moonlit night, yielded *only three* when the air was still enough to give good results, nor even then without some unsteadiness; and Bond, of Cambridge (U. S.), informed him that he had watched in vain, through no less than seventeen years, for a faultless condition of our troublesome environing medium.* Tranquillity is the first requisite for a successful astronomical photograph. The hour generally chosen for employing the sun as his own limner is, for this reason, in the early morning, before the newly emerged beams have had time to set the air in commotion, and so blur the marvelous details of his surface-structure. By this means a better definition is secured, but at the expense of transparency. Both are, at the sea-level, hardly ever combined. A certain amount of haziness is the price usually paid for exceptional stillness, so that it not unfrequently happens that astronomers see best in a fog, as on the night of November 15, 1850, when the elder Bond discovered the "dusky ring" of Saturn, although at the time no star below the fourth magnitude could be made out with the naked eye. Now, on well-chosen mountain-stations, a union of these unhappily divorced conditions is at certain times to be met with, opportunities being thus afforded with tolerable certainty and no great rarity, which an astronomer on the plains might think himself fortunate in securing once or twice in a lifetime.

For spectroscopic observations at the edge of the sun, on the contrary, the *sine qua non* is translucency. During the great "Indian eclipse" of August 18, 1868, the variously-colored lines were, by the aid of prismatic analysis, first descried, which reveal the chemical constitution of the flame-like "prominences," forming an ever-varying, but rarely absent, feature of the solar surroundings. Immediately afterward, M. Janssen, at Guntoor, and Mr. Norman Lockyer, in England, independently realized a method of bringing them into view without the co-operation of the eclipsing moon.

* "American Journal of Science," vol. xiii, p. 89.

This was done by *fanning out* with a powerfully dispersive spectroscope the diffused radiance near the sun, until it became sufficiently attenuated to permit the delicate flame-lines to appear upon its rainbow-tinted background. This mischievous radiance—which it is the chief merit of a solar eclipse to abolish during some brief moments—is due to the action of the atmosphere, and chiefly of the watery vapors contained in it. Were our earth stripped of its "cloud of all-sustaining air," and presented, like its satellite, bare to space, the sky would appear perfectly black up to the very rim of the sun's disk—a state of things of all others (vital necessities apart) the most desirable to spectroscopists. The best approach to its attainment is made by mounting a few thousand feet above the earth's surface. In the drier and purer air of the mountains, "glare" notably diminishes, and the tell-tale prominence-lines are thus more easily disengaged from the effacing luster in which they hang, as it were, suspended.

The Peak of Teneriffe, as we have seen, offers a marked exception to this rule, the impalpable dust diffused through the air giving, even at its summit, precisely the same kind of detailed reflection as aqueous vapors at lower levels. It is accordingly destitute of one of the chief qualifications for serving as a point of vantage to observers of the new type.

The changes in the spectra of chromosphere and prominences (for they are parts of a single appendage) present a subject of unsurpassed interest to the student of solar physics. There, if anywhere, will be found the key to the secret of the sun's internal economy; in them, if at all, the real condition of matter in the unimaginable abysses of heat covered up by the relatively cool photosphere, whose radiations could, nevertheless, vivify 2,300,000,000 globes like ours, will reveal itself; revealing, at the same time, something more than we now know of the nature of the so-called "elementary" substances, hitherto tortured, with little result, in terrestrial laboratories.

The chromosphere and prominences might be figuratively described as an ocean and clouds of tranquil incandescence, agitated and intermingled with water-spouts, tornadoes, and geysers of raging fire. Certain kinds of light are at all times emitted by them, showing that certain kinds of matter (as, for instance, hydrogen and "helium"*) form invariable constituents of their substance. Of these unfailing lines Professor Young counts eleven.† But a vastly greater number appear only occasionally, and, it would seem capriciously, under the stress of eruptive action from the interior. And precisely this it is which lends them such significance; for of what is going on there

* The characteristic orange line ($D_3$) of this unknown substance has recently been identified by Professor Palmieri in the spectrum of lava from Vesuvius—a highly interesting discovery, if verified.

† "The Sun," p. 193.

they have doubtless much to tell, were their message only legible by us. It has not as yet proved so; but the characters in which it is written are being earnestly scrutinized and compared, with a view to their eventual decipherment. The prodigious advantages afforded by great altitudes for this kind of work were illustrated by the brilliant results of Professor Young's observations in the Rocky Mountains during the summer of 1872. By the diligent labor of several years he had, at that time, constructed a list of one hundred and three distinct lines occasionally visible in the spectrum of the chromosphere. In seventy-two days, at Sherman (8,335 feet above the sea), it was extended to two hundred and seventy-three. Yet the weather was exceptionally cloudy, and the spot (a station on the Union Pacific Railway, in the Territory of Wyoming) not perhaps the best that might have been chosen for an "astronomical reconnaissance."*

A totally different kind of solar research is that in aid of which the Mount Whitney expedition was organized in 1881. Professor S. P. Langley, Director of the Alleghany Observatory in Pennsylvania, has long been engaged in the detailed study of the radiations emitted by the sun; inventing, for the purpose of its prosecution, the "bolometer,"† an instrument twenty times as sensitive to changes of temperature as the thermopile. But the solar spectrum as it is exhibited at the surface of the earth is a very different thing from the solar spectrum as it would appear could it be formed of sunbeams, so to speak, *fresh from space*, unmodified by atmospheric action. For not only does our air deprive each ray of a considerable share of its energy (the total loss may be taken at twenty to twenty-five per cent when the sky is clear and the sun in the zenith), but it deals unequally with them, robbing some more than others, and thus materially altering their relative importance. Now, it was Professor Langley's object to reconstruct the original state of things, and he saw that this could be done most effectually by means of simultaneous observations at the summit and base of a high mountain. For, the effect upon each separate ray of transmission through a known proportion of the atmosphere being (with the aid of the bolometer) once ascertained, a very simple calculation would suffice to eliminate the remaining effects, and thus virtually secure an extra-atmospheric post of observation.

The honor of rendering this important service to science was adjudged to the highest summit in the United States. The Sierra Nevada culminates in a granite pile, rising, somewhat in the form

* R. D. Cutts, "Bulletin of the Philosophical Society of Washington," vol. i, p. 70.

† This instrument may be described as an electric balance of the utmost conceivable delicacy. The principle of its construction is that the conducting power of metals is diminished by raising their temperature. Thus, if heat be applied to one only of the wires forming a circuit in which a galvanometer is included, the movement of the needle instantly betrays the disturbance of the electrical equilibrium. The conducting wires or "balance-arms" of the bolometer are platinum-strips $\frac{1}{120}$ of an inch wide, and $\frac{1}{2000}$ of

of a gigantic helmet fronting eastward, to a height of 14,887 feet. Mount Whitney is thus entitled to rank as the Mont Blanc of its own continent. In order to reach it, a railway journey of 3,400 miles, from Pittsburg to San Francisco, and from San Francisco to Caliente, was a brief and easy preliminary. The real difficulty began with a march of 120 miles across the arid and glaring Inyo Desert, the thermometer standing at 110° in the shade (if shade there were to be found). Toward the end of July, 1881, the party reached the settlement of Lone Pine at the foot of the Sierras, where a camp of low-level observations was pitched (at a height, it is true, of close upon 4,000 feet), and the needful instruments were unpacked and adjusted. Close overhead, as it appeared, but in reality sixteen miles distant, towered the gaunt and rifted and seemingly inaccessible pinnacle which was the ultimate goal of their long journey. The illusion of nearness produced by the extraordinary transparency of the air was dispelled when, on examination with a telescope, what had worn the aspect of patches of moss, proved to be extensive forests.

The ascent of such a mountain with a train of mules, bearing a delicate and precious freight of scientific apparatus, was a perhaps unexampled enterprise. It was, however, accomplished without the occurrence, though at the frequent and imminent risk, of disaster, after a toilsome climb of seven or eight days through an unexplored and, to less resolute adventurers, impassable waste of rocks, gullies, and precipices. Finally a site was chosen for the upper station on a swampy ledge, 13,000 feet above the sea; and there, notwithstanding extreme discomforts from bitter cold, fierce sunshine, high winds, and, worst of all, "mountain-sickness," with its intolerable attendant debility, observations were determinedly carried on, in combination with those at Lone Pine, and others daily made on the highest crest of the mountain, until September 11th. They were well worth the cost. By their means a real extension was given to knowledge, and a satisfactory definiteness introduced into subjects previously involved in very wide uncertainty.

Contrary to the received opinion, it now appeared that the weight of atmospheric absorption falls upon the upper or blue end of the spectrum, and that the obstacles to the transmission of light-waves through the air diminish as their length increases, and their refrangibility consequently diminishes. A yellow tinge is thus imparted to the solar rays by the imperfectly transparent medium through which we see them. And, since the sun possesses an atmosphere of its own, exercising an unequal or "selective" absorption of the same character, it follows that, if both these dusky-red veils were withdrawn, the true color of the photosphere would show as a very dis-

an inch thick, constituting metallic *antennæ* sensitive to the chill even of the fine dark lines in the solar spectrum, or to changes of temperature estimated at $\frac{1}{10000}$ of a degree centigrade.

tinct blue *—not merely *bluish*, but a real azure just tinted with green, like the hue of a mountain-lake fed with a glacier-stream.

Moreover, the further consequence ensues, that the sun is hotter than had been supposed; for, the higher the temperature of a glowing body, the more copiously it emits rays from the violet end of the spectrum. The blueness of its light is, in fact, a measure of the intensity of its incandescence. Professor Langley has not yet ventured (that we are aware of) on an estimate of what is called the "effective temperature" of the sun—the temperature, that is, which it would be necessary to attribute to a surface of the radiating power of lamp-black to enable it to send us just the quantity of heat that the sun does actually send us. Indeed, the present state of knowledge still leaves an important hiatus—only to be filled by more or less probable guessing—in the reasoning by which inferences on this subject must be formed; while the startling discrepancies between the figures adopted by different and equally respectable authorities sufficiently show that none are entitled to any confidence. The amount of heat received in a given interval of time by the earth from the sun is, however, another matter, and one falling well within the scope of observation. This, Professor Langley's experiments (when completely worked out) will, by their unequaled precision, enable him to determine with some approach to finality. Pouillet valued the "solar constant" at 1·7 "calories"; in other words, he calculated that, our atmosphere being supposed removed, vertical sunbeams would have power to heat in each minute of time, by one degree centigrade, 1·7 gramme of water for each square centimetre of the earth's surface. This estimate was raised by Crova to 2·3, and by Violle in 1877 to 2·5;† Professor Langley's new data bring it up (approximately as yet) to three calories per square centimetre per minute. This result alone would, by its supreme importance to meteorology, amply repay the labors of the Mount Whitney expedition.

Still more unexpected is the answer supplied to the question, Were the earth wholly denuded of its aëriform covering, what would be the temperature of its surface? We are informed in reply that it would be *at the outside* 50° of Fahrenheit below zero, or 82° of frost. So that mercury would remain solid even when exposed to the rays—undiminished by atmospheric absorption—of a tropical sun at noon.‡ The paradoxical aspect of this conclusion—a perfectly legitimate and reliable one—disappears when it is remembered that under the imagined circumstances there would be absolutely nothing to hinder radiation into the frigid depths of space, and that the solar rays

* Defined by the tint of the second hydrogen-line, the bright reversal of Fraunhofer's F. The sun would also seem—adopting a medium estimate—three or four times as brilliant as he now does.

† "Annales de Chimie et de Physique," tome x, p. 360.

‡ S. P. Langley, "Nature," vol. xxvi, p. 316.

would, consequently, find abundant employment in maintaining a difference of 189° * between the temperature of the mercury and that of its environment. What we may with perfect accuracy call the *clothing function* of our atmosphere is thus vividly brought home to us; for it protects the teeming surface of our planet against the cold of space exactly in the same way as, and much more effectually than, a lady's seal-skin mantle keeps her warm in frosty weather. That is to say, it impedes radiation. Or, again, to borrow another comparison, the gaseous envelop we breathe in (and chiefly the watery part of it) may be literally described as a "trap for sunbeams." It permits their entrance (exacting, it is true, a heavy toll), but almost totally bars their exit. It is now easy to understand why it is that on the airless moon no vapors rise to soften the hard shadow-outlines of craters or ridges throughout the fierce blaze of the long lunar day. In immediate contact with space (if we may be allowed the expression) water, should such a substance exist on our enigmatical satellite, must remain frozen, though exposed for endless æons of time to direct sunshine.

Among the most noteworthy results of Professor Langley's observations in the Sierra Nevada was the enormous extension give by them to the solar spectrum in the invisible region below the red. The first to make any detailed acquaintance with these obscure beams was Captain Abney, whose success in obtaining a substance—the so-called "blue bromide" of silver—sensitive to their chemical action enabled him to derive photographic impressions from rays possessing the relatively great wave-length of 1,200 millionths of a millimetre. This, be it noted, approaches very closely to the theoretical limit set by Cauchy to that end of the spectrum. The information was accordingly received with no small surprise that the bolometer showed entirely unmistakable heating effects from vibrations of the wave-length 2,800. The "dark continent" of the solar spectrum was thus demonstrated to cover an expanse nearly eight times that of the bright or visible part.† And in this newly discovered region lie three fifths of the entire energy received from the sun—three fifths of the vital force imparted to our planet for keeping its atmosphere and ocean in circulation, its streams rippling and running, its forests growing, its grain ripening. Throughout this wide range of vibrations the modifying power of our atmosphere is little felt. It is, indeed, interrupted by

* Sir J. Herschel's estimate of the "temperature of space" was 239° Fahr.; Pouillet's 224° Fahr. below zero. Both are almost certainly much too high. See Taylor, "Bulletin of the Philosophical Society of Washington," vol. ii, p. 73; and Croll, "Nature," vol. xxi, p. 521.

† This is true only of the "normal spectrum," formed by reflection from a "grating" on the principle of interference. In the spectrum produced by refraction, the red rays are *huddled together* by the distorting effect of the prism through which they are transmitted.

great gaps produced by absorption *somewhere;* but, since they show no signs of diminution at great altitudes, they are obviously due to an extra-terrestrial cause. Here a tempting field of inquiry lies open to scientific explorers.

On one other point, earlier ideas have had to give way to better-grounded ones derived from this fruitful series of investigations. Professor Langley has effected a redistribution of energy in the solar spectrum. The maximum of heat was placed by former inquirers in the obscure tract of the infra-red; he has promoted it to a position in the orange approximately coincident with the point of greatest luminous intensity. The triple curve, denoting by its three distinct summits the supposed places in the spectrum of the several maxima of heat, light, and "actinism," must now finally disappear from our text-books, and with it the last vestige of belief in a corresponding threefold distinction of qualities in the solar radiations. From one end to the other of the whole gamut of them, there is but one kind of difference—that of wave-length, or frequency in vibration; and there is but one curve by which the rays of the spectrum can properly be represented—that of energy, or the power of doing work on material particles. What the effect of that work may be depends upon the special properties of such material particles, not upon any recondite faculty in the radiations.

These brilliant results of a month's bivouac encourage the most sanguine anticipations as to the harvest of new truths to be gathered by a steady and well-organized pursuance of the same plan of operations. It must, however, be remembered that the scheme completed on Mount Whitney had been carefully designed, and in its preliminary parts executed, at Alleghany. The interrogatory was already prepared; it only remained to register replies, and deduce conclusions. Nature seldom volunteers information: usually it has to be extracted from her by skillful cross-examination. The main secret of finding her a good witness consists in having a clear idea beforehand what it is one wants to find out. No opportunities of seeing will avail those who know not what to look for. Thus, not the crowd of casual observers, but the few who consistently and systematically *think*, will profit by the efforts now being made to rid the astronomer of a small fraction of his terrestrial impediments. It is, nevertheless, admitted on all hands that no step can at present be taken at all comparable in its abundant promise of increased astronomical knowledge to that of providing suitably elevated sites for the exquisite instruments constructed by modern opticians.—*Edinburgh Review.*

## SKETCH OF SIR HENRY ROSCOE.

HENRY ENFIELD ROSCOE, F. R. S., now Sir Henry Roscoe, is a grandson of William Roscoe, of Liverpool, the distinguished merchant-historian, and a son of Henry Roscoe, Esq., barrister-at-law, and was born January 7, 1833. He was educated at Liverpool High School, University College, London, and Heidelberg. He was appointed Professor of Chemistry at Owens College, Victoria University, Manchester, a chair which he has held with distinguished honor to himself and credit to English science, in 1858, and was elected a Fellow of the Royal Society in 1863. His life has been marked by a bright line of investigations in chemistry from which have been derived material additions to the scope and exactness of the science; by numerous addresses before both scientific and popular audiences, and publications in which the breadth and accuracy of his thought are well matched by the clearness and frequent pungency of its expression, and the style is always adapted to the audience the effort is intended to reach; by labors to encourage original scientific research and the presentation of the most exalted aims as its object; and by his activity in the promotion of well-considered practical efforts for the diffusion of scientific knowledge among the people.

The nature of the scientific labors by which he is chiefly distinguished is set forth in the award of the Royal medal made to him by the Royal Society in 1873, which was "for his various chemical researches, more especially for his investigations of the chemical action of light, and of the combinations of vanadium."

The researches on the chemical action of light here spoken of were carried on by him and Bunsen together; and he most modestly refers to them in a biography of Bunsen, published by him in "Nature" of April 28, 1881, as investigations "with the carrying on of which the writer of this article had the great good fortune and pleasure to be concerned, and in which he had full opportunity of admiring Bunsen's untiring activity and wonderful manipulative power."

In the winter of 1866–'67 he started in Manchester a course of thirteen penny scientific lectures for the people, in which he was assisted by Professor Jevons, Dr. Alcock, and Dr. Morgan. The attempt thus made to solve the problem whether the working-men would really appreciate the value of science-instruction when given in a plain but scientific manner, illustrated with diagrams and experiments made on a scale to be seen by a large audience, was highly successful. The lectures were attended by more than four thousand persons of exactly the class for whom they were designed, and they showed themselves interested and appreciative. A syllabus of the chief points of Professor Roscoe's four lectures was printed and given to each person entering

the room; and phonographic reports of all the lectures were printed and largely sold for a penny each at the door of the hall. This experiment was so successful that it was repeated in the following years; and when, in 1875, the first six series of lectures, in which many other most eminent scientific men had taken part, were published in three volumes under the supervision of Professor Roscoe, he was able to state that each lecture on the average during the six years had been attended by nearly one thousand persons, and that from five to ten thousand copies of the penny reports of each had been sold, while the demand for back numbers still continued.

The idea of educating the people, especially artisans, in science, is one which Professor Roscoe has held much at heart and on which he has spoken often and to the purpose. Yet he has not failed to see that the problem was a complicated one, surrounded by many difficulties, and that progress in solving it would have to be made deliberately and slowly. In 1871 he wrote in "Nature" concerning a proposition for the establishment of a national working-men's university, to be founded with special reference to instruction in those subjects which have a direct bearing on the arts and manufactures, recognizing the desirabilty of providing for instruction of the kind, but, foreseeing the danger of any attempt to secure it failing, through lack of means or want of good management. He estimated that an income of from £80,000 to £100,000 would be needed to support a people's university on a truly national scale, anything less than which would be a practical failure. But the financial difficulties, he added, were by no means the only or most important ones which would beset the new university. These would only begin to be felt when the scheme had been started —"such as dangers of giving an instruction too purely theoretic, or of running into the worse evil of teaching details without scientific *aperçu*."

A few years after this, we find him engaged in a discussion respecting the teaching of science in schools, in which he supported the position that no satisfactory advantage could accrue from this sort of instruction, until the subject was "placed upon its true position of *educational equality*, both as regards range and time, with classics and mathematics, and no system of regulations or of examinations can be said to fulfill its object in which this position is ignored." "I am fully aware," he said, in another letter, "of the importance of a firm mathematical foundation, and I am far from wishing to overwhelm the younger boys with science before they have mastered the elements of arithmetic and grammar and languages. . . . The mistake, as it seems to me, which is prevalent respecting science-teaching in schools, is the notion that it is a subject to be *lectured* upon for two hours per week to those already educated, and who show an aptitude for it, while it can and ought to be introduced at a definite period as a regular part of *school-work*. It is now usually made an extra subject, a *quasi-*

amusement, put on the same footing as drilling or drawing, while it can and ought to be made as much a discipline as the Latin grammar or Euclid, affording as it does, in my opinion, if properly taught, an excellent training-ground for acquiring that reasoning power and habit of application which it is usually supposed can only be gained through one or other of these older channels. . . . The Balliol scholarship and the other great university 'advertisements' I believe to be in many ways stumbling-blocks in the path of true education in this country. . . . Are we never to break loose from this degrading Moloch of examination? I . . . look forward with hope to the ultimate emancipation of school-boys from their ancient fetters. Then those subjects will be taught at school which are best suited to make the mass of boys good citizens, and to forward the highest interests of the country instead of the great aim of the schoolmaster being to secure a Balliol scholarship."

His views of the scope, objects, and benefits of science were presented in his address at the opening of the new building of Owens College, Manchester, in 1873, the subject of which was "Original Research as a Means of Education," when he said:

"It does not take long to convince us that almost every great material advance in modern civilization is due, not to the occurrence of hap-hazard or fortuitous circumstances, but to the long-continued and disinterested efforts of some man of science. Nor do I need to quote many examples to show us the immediate dependence of the national well-being and progress upon scientific discoveries thus patiently and quietly made."

In other parts of this address he laid down these principles:

"The essence of the scientific spirit is, first, that it is free and disinterested; second, that it knows nothing of tradition or authority, but lays down laws for itself, and refuses to be bound by any others. Scientific education starts in simple communion with Nature, and is content to pick up little by little the truth which she is always ready to communicate to patient listeners. The process is at once opposed to and, if successfully carried out, subversive of the old order of things. Between a system based on authority and one founded on freedom of thought and opinion, there never can be united action; and, while fully acknowledging that intellectual and moral excellence are common to all classes of men, it is as well that we should admit that the followers of the old system have no claim to be called scientific, and that there is, from the nature of things, a great and impassable gulf between us and them. I must, however, here be not misunderstood. It would ill become me . . . to undervalue or depreciate the study of subjects other than those included under the head of the physical sciences. Literary studies, whether of modern or ancient authors, giving an acquaintance with the noblest thoughts and opinions of the great men of past ages; historical studies, giving us a knowledge of the acts of men in times

gone by; the study of language and philology, as giving a knowledge of how men of all times and countries express their ideas and language; of logic, as pointing out the laws of thought; and, above all, that of mathematics—are all matters of the highest importance, the neglect of which would render our education incomplete and poor indeed. The same rules, however, which all acknowledge to be necessary for the teaching of physical science must be applied to the study of all these subjects. In short, the *scientific* method must be employed in all cases and carried out to its fullest extent." He followed these observations with a protest against the supposed materialistic tendency of scientific studies, saying: "It is true that certain opinions and professions of belief have been and will be shaken by studying the book of Nature; it is also equally true that the study of Nature does not and can not interfere with the highest and noblest aspirations of the mind of man. In the investigations of every branch of science we come at last to a point at which further inquiry becomes impossible, and we are obliged to acknowledge our powerlessness and insignificance. We can see and learn concerning only the minutest fraction of the great whole of Nature, and it is with this minute fraction alone that we, as men of science, are concerned."

Speaking of the advantage of experimental scientific research, he said that the faculties which are called into operation by its prosecution "are, in fact, exactly those which are valuable in the every-day occurrences of life, the proper employment of which leads to success in whatever channel they may happen to be directed. A man who has learned how successfully to meet the difficulties and overcome the obstacles which occur in every experimental investigation, is able to grapple with difficulties and obstacles of a similar character with which he comes in contact in after-life. It is the greatest possible mistake to suppose—as, unfortunately, many yet do—that a scientific education unfits a man for the pursuits of ordinary professional or commercial life. I believe that no one can be unfitted for business life or occupations by the study of phenomena all of which are based upon law, the knowledge of which can only be obtained by the exercise of exact habits of thought and patient and laborious effort."

Further, concerning the ennobling nature of original scientific inquiry: "Although I should be the last to contend that men of science are free from the foibles and weakness common to all mankind, I think it stands to reason that the habits of mind which an investigator must cherish are such as must raise him above the petty struggles of ordinary existence, and must, for a time at least, lift him into an atmosphere free from the cloud and smoke which too often darken the usual current of men's lives."

In his opening address to Section B, of the British Association, in 1870, he spoke of a humane and civilizing mission which science might accomplish aside from its direct end, saying, after a reference to the

Franco-Prussian War, then in progress: "And here may I remind you of the cosmopolitan character of science, of the fact that it is mainly to the brotherly intercourse of those interested in science, and in its application to the arts and manufactures in different countries, that we must look as the small but living fire which in the end will surely serve to melt down national animosities, and to render impossible the breaking out of disasters so fatal to the welfare of humanity as that of which we are now unfortunately the spectators?"

Besides the researches to which reference has already been made, and numerous papers in the "Philosophical Transactions" and the scientific periodicals, Professor Roscoe has published "Lessons in Practical Chemistry," a work which has been translated into German, Russian, Hungarian, and Italian, and republished in this country; "Lectures on Spectrum Analysis," of which a fifth edition was published in 1878; a "Junior Course of Practical Chemistry," prepared by himself and Francis Jones in 1873; and, conjointly with Professor Schorlemmer, a large "Treatise on Chemistry," in three volumes. The last work was pronounced by "Nature," in a review of the first two volumes, one which, "when finished, will afford the most complete systematic exposition of the existing state of chemical science that has yet appeared in the English language"; and by Professor Watts as forming a treatise on inorganic chemistry "of which English science may well be proud." To "Nature" he contributed affectionate biographies of Liebig and Bunsen. He was also joint editor, with Professor Huxley and Balfour Stewart, of Macmillan's "Science Primer" series, and author of the "Primer of Chemistry." He is Examiner in Chemistry to the Science and Art Department. He was elected President of the Chemical Society of London in 1880, President of the Literary and Philosophical Society of Manchester in 1882; and is a member of the Royal Commission on Technical Instruction. He was knighted in 1884, at about the time of the meeting of the British Association at Montreal.

# EDITOR'S TABLE.

*HARRISON AND SPENCER ON RELIGION.*

WE print the concluding portion of a controversy between Frederic Harrison and Herbert Spencer on the nature of religion. In an article which appeared in the "Monthly" of last January, Mr. Spencer took a retrospective view of the past tendencies of religious ideas, and on the basis of this pointed out the further changes that may be expected in the future. His conclusion was a reaffirmation of views laid down many years ago, that there is a verity at the foundation of all religious systems, which will permanently remain when the erroneous beliefs accompanying this verity are utterly swept away by the progress of science. Mr. Spencer thus arrays himself, not with those who deny but with those who affirm the validity of religion, or that there is a reality at the root of all the diverse, discordant, and changing faiths professed by mankind. Religion is held to pertain to the sphere of the emotions, and to consist essentially in the feelings which arise in human nature toward the unsolved and forever insoluble mystery of the universe. Mr. Spencer says that, "unlike the ordinary consciousness, the religious consciousness is concerned with that which lies beyond the sphere of sense." It therefore relates to that which can not be grasped by the intellect, but which lies beyond the range of knowledge. That which is the object of religious feeling can not be known in any sense of our usual knowledge. Mr. Spencer reasons that it is not a negation, but a positive reality; and, preferring to use a term connotive of true humility and the limitations of the human mind, he calls this mysterious object of religious feeling "The Unknowable."

Mr. Harrison attacked this view of Spencer in an article which appeared in the August "Monthly" under the title of "The Ghost of Religion." He maintained that Mr. Spencer had perpetrated an utterly destructive criticism of everything hitherto known as religion; and argued that the attempt to find anything like a common element in religious systems is futile, while the doctrine of the Unknowable is but a vain attempt to deify an all-nothingness. His position, therefore, was, that there is no element of truth whatever in any of the systems that have passed under the name of religion. Yet Mr. Harrison will not give up the term religion. He proposes to retain it, redefine it, and make a new application of it. He says it is duty, virtue, morality, and finds its highest expression in a worship of humanity.

Mr. Spencer rejoined to this criticism in an article printed in the same number of the "Monthly," under the title of "Retrogressive Religion." He replied to Mr. Harrison's criticisms of the doctrine of the Unknowable, and then subjected to a close examination Mr. Harrison's view of the Religion of Humanity. Mr. Harrison replies in an article entitled "Agnostic Metaphysics." It is very long, and divided into three parts. The first contains all that is essential to the main controversy; and, as we can not afford room for his less important expansions of the discussion, we print herewith the first portion, which is all that is properly covered by his title, and the part to which Mr. Spencer's answer is chiefly confined—which answer also appears in the present "Monthly."

We have felt bound to lay this discussion before our readers, because it is undoubtedly of profound importance. It goes to the root of the issue be-

tween science and religion, and is really a contest over the vital question whether there is, or is to be in future, any recognition of any such thing as truth in the religious sphere of human experience. In the issue as thus made up, Herbert Spencer is on the religious side. He affirms that man is a religious being, that the religious sentiments have their proper object, that science can carry away only errors of theological belief, and that the basis of religious feeling must be as permanent in the future as it has been in the past. This Mr. Harrison denies, and maintains the absolute groundlessness of all religious conceptions or sentiments which have been embodied, however obscurely, in the past beliefs and aspirations of mankind.

Mr. Harrison says that he warned Mr. Spencer ten years ago that "his religious doctrine of the Unknowable was certain to lead him into strange company." The apprehended danger was, that the ground taken by Spencer on religion might at length find acceptance with religious people, and now he intimates that this disaster, against which he raised his voice of warning, has actually occurred; that is, religious people are coming into agreement with Mr. Spencer. We indulged in a similar prophecy more than twenty years ago, though in no spirit of dread or warning. We said that as science went on with its inexorable work of criticism, undermining and overthrowing theological errors, the stern question would certainly arise whether anything whatever was to be left; and that there would then be a far higher appreciation of the position taken by Spencer, that the essentials of religion are indestructible in human nature. For maintaining this doctrine in the form which he gave it, Mr. Spencer was denounced as a materialist, an atheist, and the destroyer of religion. But, now that his views are better understood, it begins to be acknowledged on the one hand that he has rendered a great service to the religious side, while the undisguised enemies of all religion are making war upon him because there is a tendency among the most enlightened religious people to favor his ideas. Yet the whole burden of Harrison's argument is to show that the doctrine of the Unknowable is inadequate as a religious basis, because the people will never be able to appreciate it. But time may rapidly change the possibilities of appreciation as implied by his own warning of ten years ago, which he now declares is being fulfilled. It is to be remembered that Mr. Harrison does not deny, but virtually concedes, the validity of the doctrine of the Unknowable as a logical formula or philosophical proposition, which, of course, is to admit that there is truth in it. But he says it belongs to philosophy, and denies that it has or can have any religious significance. Yet Mr. Spencer has proved that it is the fundamental and central truth of all the religions that have existed and had power over mankind. Mr. Harrison can not deny the essential religious character of this view without vacating the fundamental conception of religion and uprooting it from human nature. This he aims to do in his discussion, and then coolly proceeds to put something else in its place.

There therefore can be no hesitation about classing Mr. Harrison as an inveterate antagonist of religion. Taking the meaning that the world has hitherto given to the word, he scouts it as pure illusion. Yet he will not admit that he is the enemy of religion. As we have said, he believes in and is laboring to found and extend a new religion. We only complain that in doing this he wrests the word from its old and established meaning and gives it a novel and perverted application. In place of the religions which have made the Divine Power an object of worship, he would substitute the worship of

man and the religion of humanity as invented and expounded by Comte. Of course, the new view can only be accepted by the abandonment of the old, and we very much doubt if the world will approve or accept the change. It is incongruous and fantastic, and would be incredible, but for the ridiculous fact that a little sect is actually trying to adopt and carry it out. A writer in an English newspaper, who had visited the Little Bethel of the Comteists to witness the services on the eve of the *fête* of the founder of the new religion, thus describes what he saw: "When I entered Dr. Congreve was reading the service for the day. He had an audience of some thirty persons, several of them young ladies who had evidently come to be startled. The sermon was preached by Mr. Crompton. If he is a 'priest' of the new dispensation, he wears no clerical attire. Perhaps the year 96 of the Comteist era (for they have, like the French Republic, their own era) is too early for the invention of sacerdotal robes. The preacher came to a desk draped in red baize, and for a half-hour poured forth a rhapsody upon Auguste Comte, Clothilde de Vaux, progress, order, unity, and love, which was chiefly remarkable for the free use of Christian language to set forth a faith (if it can be called a faith) antagonistic to Christianity. The poor wife of Comte, who left him, was dismissed with a word of scorn for one who was incapable of sharing the honors of greatness; and Clothilde, the mistress, was extolled to the skies for her devotion to her distinguished lover. Comte and Clothilde were declared to be the two greatest people who had visited this earth; and the peroration was a sort of ascription to them. It was startling to hear the organ, as the preacher sat down, peal forth that beautiful phrase from Mendelssohn's 'Elijah' so often heard as a Kyrie, and associated in the oratorio with the words 'Bend down from heaven and grant us thy peace. Help, Lord, thy servants; help, O God!' Dr. Congreve then rose and said, 'Let us pray.' Everybody stood. 'We praise thee, Humanity,' said Dr. Congreve, 'as for all thy servants, so especially for Auguste Comte; and we pray that, in proof of our gratitude, we may become thy more willing and complete servants.' The prayer went on to talk of 'the queen of our devotion, the lady of our loving service, the one center of all our being, the one bond of all ages, the one shelter for all the families of mankind, the one foundation of a truly catholic church. To thee be all honor and glory. Amen!' Then came a parody of the benediction given in the name of Humanity: 'The peace of her slowly dawning kingdom be upon you, the blessing of Humanity abide with you, now and forever.' The organ played again, and the little audience departed."

The devotees of this new religious cult may be sincere, but they are none the less absurd; and to call this result of insane egotism—the substitution of man for God as an object of worship—by the name of *religion*, is to take liberties with the meanings of words which, if carried out, would reduce all language to a state of chaos.

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### *A HEALTHY MATERIALISM.*

In spite of the intellectual advancement of our age, men are still to far too great an extent under the dominion of mere words. If there is any habit which science is destined to break up and dispel it is this. Science must do it, because it is pre-eminently the knowledge of things, and to know *things* should make the mere *names of things* sit lightly upon one. Words have seized the throne of man's reason; they command, and he obeys. It is time to dethrone them, to break their spell over the human mind, to teach every human being to ask without dismay: "What is the reality of

this thing to which so terrible — or mayhap so imposing or so attractive— a name is given? Let us not stop at the name; let us get at the facts."

Now, one of the most appalling terms —to some—of modern philosophical discussion is "materialism." To others —a much smaller number—it stands for the only true scientific gospel. We think, therefore, that we shall be rendering a useful service if we try to show, and succeed in showing, as we think we can, that there are two kinds of materialism—one a healthy kind which has an unshakable foundation in Nature, and which no one need dread to accept; the other an unhealthy kind that fortunately has no foundation anywhere, but exists as a wholly illegitimate construction in the minds of those who cherish it.

What matter is we know not, and do not need to know. We know how our minds are impressed when we speak of matter; we know, in other words, what kind of consciousness we have when matter is an object of thought or feeling. In the same way, without knowing what mind is, we know what we are conscious of when we think of mind. Now, if there is anything in this world we are sure of, it is that mental manifestations are governed by physical conditions. It is needless to go over the familiar arguments, when any one who disputes the general position is found talking to a drunken man just as he would to a sober one, or to a delirious patient just as he would to a person in sound health—in other words, taking no account of the physical conditions which have confused the mental operations of either unfortunate—then we shall believe that he means what he says; only, we may then have to conclude that he is either drunk or delirious himself. Further, we know that mental constitutions, like bodily ones, are inherited. We expect children to resemble their parents in character as well as in person. We expect to find, and do in general find, certain broad national characteristics in people of a certain race. We look for enterprise and tenacity in the Anglo-Saxon stock; we look for a predominant emotionalism in the Celtic; we look for ready submission to power in Eastern races; we look for alternate restlessness and indolence in our Indian tribes. All this simply means that mind manifests itself under quite as definite forms as any of the phenomena of the physical universe, and that we know where to look for each variety. Again, mental powers and aptitudes depend to a considerable extent on education and upon the opportunities that life brings with it. We do not expect, in matters intellectual any more than in matters agricultural, to reap where we have not sown, or to gather where we have not strewed. The experience of that ancient saint who woke one fine morning, and found himself in full possession of half a dozen languages of which the day before he knew not a word, is not repeated in modern times. Nowadays, we have to learn before we know.

The dependence, therefore, of mind, or at least of its manifestations—and of nothing else do we know anything—on physical or material conditions may be taken as an incontrovertible fact. If, therefore, the term "materialism" had been confined, as it might have been, to the expression of this fact, would there have been anything terrible in it? To use Comte's illustration, would any one think it a dangerous concession to make to admit that he could not work out intellectual problems to advantage standing on his head? Surely the materialism which teaches a man that, if he would exercise his mind to advantage he must eat moderately, and in general economize his physical powers, is not a very deadly doctrine. Yet that doctrine might very aptly and properly be called materialism; just as we call spiritualism the converse doctrine that, if a man wants a piano or

other heavy body lifted without taxing any one's muscles, the best way to do it is to hire a medium who will engage a disembodied spirit to do the job. Materialism in the sense above limited, far from threatening any injury to or derogating from the dignity of mind, is the very thing that will most help to bring mind to the highest perfection, while it promotes its dignity by making all material things subservient to it.

But there is another point of view. This doctrine, far from being of a radical and disturbing kind, is eminently conservative and favorable to intellectual order. Why? Because it establishes the truth that mind is not an unconditioned entity, as some are inclined to regard it, but a thing strictly conditioned and limited. The world ought by this time to have got over the old metaphysical notion of the absolute independence of mind, but it has not, in point of fact, got over it; and, strange to say, some of those who hold most strongly to the old error are professed freethinkers. In fact, we are not sure but that the ranks of technical "free-thought" are to day the very citadel of that error. It seems to be continually assumed that the vindication of the right of free-thought carries with it an assertion of the *competency* of every man's thought for all possible intellectual enterprises. Here we see the old idea of the mind as a kind of impalpable essence of absolutely unlimited powers, tethered neither to time, to place, nor to circumstances. But supposing the opposite truth were universally and frankly recognized, that each man's mind was simply what circumstances past and present had made it, a man would not in claiming free thought feel, as so many do now, that he was asserting his right and his competency to deal with all problems in heaven and on earth, but simply that he was asserting his right to exercise that *limited* activity for which his mind was adapted. A man whose body was in durance would not, in claiming physical liberty, fall under the illusion that if he could once gain his liberty he would be competent with his body to perform all manner of gymnastic feats. No; because he knows what his body is fit for, what it has been trained to, and what lies altogether beyond its powers, natural and acquired. If, when he had obtained his liberty, somebody wanted him to attempt at once, by way of marking and emphasizing his perfect freedom from physical control, some very difficult and dangerous athletic feat to which he had never been accustomed, he would be wise if he turned a deaf ear to the suggestion; or, rather, he would be an extraordinary fool if he listened to it. Yet it will scarcely be maintained that exactly similar folly is not often practiced by way of emphasizing freedom from mental control—that is to say, that men rush at the most difficult intellectual problems without any preliminary consideration of the question of their competency for dealing with them successfully or hopefully. As long as they arrive at some conclusion which they can fling in the faces of their supposed opponents as a trophy of free-thought, they are satisfied. The remedy for this kind of folly is plain. It lies in the "materialistic" doctrine, as we claim the right to call it, that the mind is as limited a thing as the body, and that *therefore* we can not properly assign any more extensive meaning to freedom of the mind than we do to freedom of the body. Both kinds of freedom are good, but neither confers new powers, except in so far as the exercise which freedom makes possible tends to develop power. Power, however, is only developed by rational exercise; bodily growth can be arrested, and the bodily frame twisted out of shape, by excessive or ill-directed exercise; and precisely so with the mind. While, therefore, we have all possible sympathy with the claim for freedom of thought, we wish we could always

be certain that those who make the claim were "materialistic" enough to recognize that they were claiming the right to exercise faculties of a strictly limited kind, the particular limitations varying from man to man, and that they must not expect the world to look on with admiration at attempts to make mere "freedom" supply the place and do the work of knowledge and competency. To all of every school who adhere to the old metaphysical views of mind, and who hold themselves possessors of an organ of unlimited powers, we would say: "You are under an error; your mind is tethered to your body, it is tethered to its own past history, it is tethered to a long line of ancestry. Some things it can do, because they fall within its tether; others it can not do, because they fall beyond. Be wise, try to find out what your limitations are, and proportion your intellectual tasks to the width of your intellectual shoulders." Such are the teachings of a healthy materialism, at once the most conservative and the most progressive of doctrines.

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### *POLITICS AND SCIENCE.*

THE collocation of ideas expressed in this title is not generally regarded as valid or established; but they are unquestionably coming every day into closer relation. The recent campaign, at any rate, is full of suggestion in regard to important principles with which it is the office of Science to deal in the working of practical politics.

The scientific habit of mind is that, above all, which links cause with effect and effect with cause, and which, in special phenomena, seeks always to discover the illustration of some general law. In the recent contest the excitement was almost unparalleled. For a time the whole nation was in a condition which, in the physical life of the individual, would be represented by a state of high fever. We have heard a good deal about "the splendid conduct of the people," and certainly it spoke well for the sense of responsibility of the citizens generally that they refrained from acts of disorder. It is, however, a question whether there was anything very admirable in the excitement itself, or in the causes of it. It is a further question of much gravity whether such periods of excitement can be repeated with safety. Can we count upon the same admirable self-control on future occasions, particularly when we consider how little confidence each party seems to possess in the honesty and fair-dealing of the other? These are serious questions and call for an answer from every thoughtful citizen.

The excitement of the late contest was largely due to the fact that it was a conflict not so much of principles as of interests. We are not prepared to deny that a large number of citizens in the aggregate had their own serious views of public policy in connection with the election; but these were not among the most excited members of the community. A man who has faith in a principle will work for it, and be enthusiastic for it, but he can afford to bide his time. It is the man whose whole course is determined by party allegiance, and who has learned to recognize his political opponents as enemies, not so much of his views as of his interests, who is carried away by a kind of frenzy in times of political crisis. Such men unfortunately constitute the great majority, and hence the danger which waits upon presidential elections. The practical question which confronts us, then, is how this blind devotion to party is to be counteracted. How are men to be made ashamed of resigning their whole individuality to political leaders, who themselves are often no better than political adventurers? It is evident that what we need is an increase of intelligence in the community. We flatter ourselves, of course, that we are the most intelligent community in

the world; but, however the comparison may hold between ourselves and other nations in this respect, it is evident that we want more intelligence, more of true culture, and that such intelligence, such culture, is the only influence on which we can depend to moderate the passions which our civic contests are so prone to generate. It is to science we must look for help—to science in its widest and noblest sense. A man may possess much technical knowledge, and his practical judgment may remain narrow, and his moral nature commonplace, if not absolutely inferior. The science that elevates is not the science which is taught or learned merely as a means of gaining a living; it is not the science that sharpens greed and gives a more cunning acquisitiveness; it is the science that enables a man to live in an atmosphere of general ideas, and that makes the whole world interesting to him apart from all purely personal concerns. It is science in this sense that should be brought to bear upon the minds of the young in our schools and colleges. It is science in this sense that we contend for as an integral part of all education. It is for the lack of general scientific conceptions, supported by a basis of solid knowledge in some particular branch or branches of science, that men are to-day so largely the prey of political demagogues, and come so near losing control of their actions in times of excitement. The lesson of the election is, that our national culture is but a shallow culture, considering the vast and even dangerous responsibilities devolving upon the individual citizen. Granting even that other nations can manage to do with no higher a development of intelligence, with a distribution of knowledge no more liberal than that which exists in this republic, it does not follow that we can safely be content with our present attainments in these respects. It is well for us that the next presidential election is four years ahead. Let the intervening four years be years of earnest struggle for the advancement of science, for the spread of a true culture, that in our next crisis the influence of ideas may be a little, if ever so little, greater, and that that of personal passions a little, if ever so little, less.

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## LITERARY NOTICES.

A Compend of Geology. By Joseph Le Conte, Professor of Geology and Natural History in the University of California; author of "Elements of Geology," etc. New York: D. Appleton & Co. Pp. 399. Price, $1.50.

This is the third volume that has appeared of the new and attractive series of "Appletons' Science Text-Books." The great popularity and success of the author's larger work for colleges led to the belief, expressed by many, that he would be the best man to prepare a shorter work suited to general school use. Such works should certainly not be left to compilers, on the pretext that general introductory books are of less importance than advanced treatises. It is desirable, first of all, in preparing a good text-book, small or large, that the author should know his subject, directly and thoroughly, and then that he should be capable of presenting it in a form adapted to the grade of students for whom it is written. Professor Le Conte is a high authority in geology, a life-long student of American geology, and an examination of the present work convinces us that he has remarkable tact and judgment in adapting his exposition to the grade of mind for which this volume is intended. It is not a *primer* of geology, and makes no attempt to reduce the order of ideas, with which this science is conversant, to the capacities of children. It implies the usual mental maturity of scholars in our schools fifteen or sixteen years of age, and to these the book is made thoroughly intelligible by the effort required in class-room study. It is properly a book for beginners, and at the same time presents a view of the subject sufficiently full and complete for the general purposes of education. It is written in a simple, clear, and popular style, and is so abundantly illustrated as to

afford every advantage of pictorial representation. At the same time the work would prove valuable as an authentic account of the present condition of geological science for general reading and convenient reference.

Like all the other volumes of this series, it is presented in an elegant form and finished workmanship, alike in engraving, typography, and binding. Le Conte's compend should at once take rank as a standard school text-book.

THE DESTINY OF MAN, VIEWED IN THE LIGHT OF HIS ORIGIN. By JOHN FISKE. Boston: Houghton, Mifflin & Co. Pp. 121. Price, $1.

IT was certainly not at all surprising that Mr. John Fiske should have received an invitation to lecture before the "Concord School of Philosophy"; but it was a matter of some surprise to many that he should have accepted it. There are those who will think he was not at home there; and yet there seems to have been a propriety both in the invitation and in the acceptance of it. The Concord philosophers this year took up the question of immortality, and, as Mr. Fiske has views upon this subject, and as his opinions upon any grave philosophical question are highly valued, and as, moreover, there is a good deal of interest to know how he regards this particular problem, the Concord people must be credited with doing an excellent service in calling him out.

We shall here be able only to state Mr. Fiske's position, as to discuss his views will require a formal article; and we can not better indicate the ground he takes upon the question of immortality than in his own words in the preface, which will also afford a clew to its treatment in the book. He says: "The question of a future life is generally regarded as lying outside the range of legitimate scientific discussion. Yet, while fully admitting this, one does not necessarily admit that the subject is one with regard to which we are forever debarred from entertaining an opinion. Now, our opinions on such transcendental questions must necessarily be affected by the total mass of our opinions on the questions which lie within the scope of scientific inquiry; and from this point of view it becomes of surpassing interest to trace the career of humanity within that segment of the universe which is accessible to us. The teachings of the doctrine of evolution as to the origin and destiny of man have, moreover, a very great speculative and practical value of their own, quite apart from their bearings upon any ultimate questions. The body of this essay is accordingly devoted to setting forth these teachings in what I conceive to be their true light; while their transcendental implications are reserved for the sequel."

From this it will be seen that Mr. Fiske's volume affords a compendious presentation of the doctrine of evolution in its highest aspects as throwing light upon the origin, history, career, and possible destiny of man. As an exposition of this subject the little book is a gem of lucidity and instructiveness. Mr. Fiske has but very few peers as a clear, attractive, and brilliant writer; and on the subject here treated he writes with the authority of one who by his independent and original investigations has aided in giving shape to modern evolutionary doctrine in its higher aspects. The book is to be very strongly commended on this ground, and is certain to be widely read. The incompleteness which is a necessary result of its brevity may be supplemented by reference to the more elaborate presentation of his views in his other works; and at the close of the volume he indicates which of his larger volumes is to be consulted for this purpose and where the more elaborated opinions are to be found. Without inquiring at present into the validity of the special conclusions he has arrived at on the question of immortality, we will only say that the book taken in connection with its references is a unique and incomparable statement of evolutionary doctrine, that may be perused with equal pleasure and profit by all concerned in this class of inquiries.

SHOPPELL'S BUILDING PLANS FOR MODERN LOW-COST HOUSES. Edited by ROBERT W. SHOPPELL. New York: Co-operative Building Association. Forty Plans. Price, 50 cents.

THE houses for which plans are given are in the favorite styles of the day, and range in cost from $400 to $6,500. The designs are furnished by Stanley S. Covert and Fran-

cis K. Kane, architects. The publishers assert that being architects they are prepared to back up every profession made in the work; and that the costs of construction furnished may be relied upon. "Even in far-distant places and after the lapse of years," they say, "we can still make the prices good by some change in construction or material when making the working plans and specifications." This on condition, of course, that their working plans and specifications are obtained, for which they make a special charge of from $12 to $60, according to the character of the design.

MY FARM OF EDGEWOOD. By the author of "Reveries of a Bachelor." New York: Charles Scribner's Sons. Pp. 329. Price, $1.25.

"MY Farm of Edgewood" is, reckoning from the day of its first appearance, twenty-one years old; but it is not an old book. The world has seen changes since it was first published. American suburban life is very different from what it was then. Agriculture has made advances, and science has been revolutionized in some of its branches. But "My Farm" is as fresh and as timely as was the first copy damp from the press; and it seems destined to live a classic. It is a pastoral, a picture of an ideal life, which is also real, seen as with a poet's eye; while, on the other side, it gives a correct vision of farm-life with its bright and dark features, abounds in graphic social sketches, and is so permeated by common sense that its suggestions are capable of being made practically applicable to the concerns of common life.

FORESTRY IN THE MINING DISTRICTS OF THE URAL MOUNTAINS IN EASTERN RUSSIA. Compiled by JOHN CROUMBIE BROWN, LL. D. Edinburgh: Oliver & Boyd; Montreal: Dawson Brothers. Pp. 182.

THE plan of this treatise is not essentially different from the plans of the author's previous works on the forestry of the different European states. It divides itself into two parts—forestry west and forestry east of the Ural Mountains. In the second section, besides the condition of the forests and forest exploitation, information is given on the mining enterprises of the eastern slopes of the Ural Mountains. In a curious chapter on "Abuses in Connection with the Exploitation of the Forests," revelations appear of the corruptibility of the Russian officers, and of the tricks to which they resort to enrich themselves without seeming to take bribes.

COMPREHENSIVE ANATOMY, PHYSIOLOGY, AND HYGIENE. By JOHN C. CUTTER. Philadelphia: J. B. Lippincott & Co. Pp. 376.

THE author of this work, which is adapted for schools, academies, colleges, and families, is professor of Physiology and Comparative Anatomy in the Imperial College of Agriculture at Sapporo, Japan. In the instruction of his pupils, whose knowledge of English was not perfect, he was led to depend less upon the text-book and more upon dissections before the class, and upon demonstrations from an active coolie, and from microscopic preparations; and his book has grown up out of this method of teaching. It contains, together with the outlines of the principles of the science, brief directions for illustrative dissections of mammals, for elementary work with the microscope, for physiological demonstrations on the human body, and for the management of emergent cases. The effects of stimulants are treated without bias in the chapter on that subject. The effort is made to give all the information a practical direction.

N. W. AYER AND SON'S AMERICAN NEWSPAPER ANNUAL. Philadelphia: N. W. AYER & SON. Pp. 994. Price, $3.

THE "Annual" contains a carefully prepared list of all newspapers and periodicals published in the United States, the Territories, and the Dominion of Canada, with information respecting them and concerning the character, population, politics, resources, manufactures, and products of the places in which they are published, classified, arranged, and rearranged, in various ways. An idea of the composite character of our population is conveyed by the presence in the lists of nearly five double-columned pages of titles of German publications, not quite a page of French, 53 Scandinavian, 35 Spanish and Portuguese, 12 Bohemian, 11 Hollandish, 7 Italian, 3 Polish, 5 Welsh, one Irish, one Latin, and one Hungarian periodicals.

How we Live; or, the Human Body, and how to take care of it. By James Johonnot and Eugene Bouton, Ph. D. New York: D. Appleton & Co. Pp. 162. Price, 50 cents.

This book presents an elementary course in anatomy, physiology, and hygiene. Its method is deductive, each new topic growing out of the one that precedes it; and it aims to present the laws of life in such a practical and reasonable way that they will become a guide to living. In the treatment of each topic, function is considered before structure, and the endeavor is made to present the relations of part to function in such a way that the hygienic law applicable to the case shall follow as a matter of course. As an incentive to study, the authors have appended at the close of each chapter a list of questions on subjects suggested by the text, which will prompt the pupil to think and observe for himself.

Book of Cats and Dogs and other Friends, for Little Folks. By James Johonnot. New York: D. Appleton & Co. Pp. 96. Price, 20 cents.

The object of this book, with its entertaining stories, its extracts from Mother Goose, and its beautiful illustrations, is the pleasure and the instruction of children, and it is well adapted to it. Through their love of pets, of stories, of jingle and fun and incongruity, says the author, their little opening minds "may be led to careful observation, comparison, and descriptions —steps at once necessary to mental growth, and leading up to the portals of science. By insensible degrees, play may be made to merge into study, and fun take on the form of fact. Upon these ideas of the basis and method of thought, this little work has been constructed." The "other friends" include horses, cattle, sheep, goats, and pigs.

The True Issue, New York, G. P. Putnam's Sons, pp. 79; and Wages and Tariffs, pp. 47, by E. J. Donnell, New York, Wilcox & O'Donnell Company. Price, 10 cents.

In the former of these pamphlets, Mr. Donnell maintains that industrial depression and political corruption result from the existence of great monopolies which are fostered by the tariff. He endeavors to show that the wool-tariff is suicidal, the tariff on manufactures a sham, and that there has been no steady, genuine prosperity since the present high protective policy began. He calls iron the key to the arch of monopoly, and says it is the article with which tariff reform should begin. He suggests that, if a bounty should take the place of the tariff, the people would see what protection costs them, and whether the return justified the expenditure. In "Wages and Tariffs," which is an address delivered before the Brooklyn Revenue-Reform Club, May 8, 1884, he gives some account of protective legislation in this country, aiming to show that its effect, especially on wages, has been mischievous.

Outlines of Roman Law. By William C. Morey, Ph. D. New York: G. P. Putnam's Sons. Pp. 433. Price, $1.75.

The importance of the Roman law as a part of liberal education has been strongly emphasized of late years in England, and has received some recognition in this country. It seems now to be a well-established fact that the history of modern systems of law, and the principles of comparative jurisprudence, can not be properly understood without some knowledge of that branch. The validity of this statement, which we give almost in Mr. Morey's words, becomes obvious when we reflect that the Roman law comprised a highly perfected and elaborate system of jurisprudence that covered the whole extent of the empire through many centuries, and which avowedly constitutes the foundation of the legal systems of nearly all civilized states. The law of all Europe, except Russia and England, is built directly upon it. Recent investigations have shown that it has had much more to do with the structure of English law than the old text-books taught, and that the common law, though further removed in descent than the civil law, was in its essential features a legitimate outgrowth from it. In the United States it appears in its full force in the jurisprudence of Louisiana, which is of the civil and not of the common law, and in modified forms in the institutions of the other States, derived from the common law. Professor Morey's treatise is first historical, considering the growth of the Roman law

in four periods down to the codification by Justinian, and in a fifth period to the present time. In this part are given accounts of the study of the law and its force in different States. The second part of the book discusses the general principles of the Roman law under the heads of the law of persons, the law of things, and the law of actions.

A THOUSAND QUESTIONS IN AMERICAN HISTORY. Syracuse, N. Y.: C. W. Bardeen. Pp. 247. Price, $1.

THIS book presents an outline of the history of the United States in the form of questions and answers. It was prepared by a teacher for use in his own school, and deals not merely with events, but with causes, and with the side issues that have played important parts in American politics. It may be found a useful aid to teachers in directing their attention to the events and aspects of events on which they can make their classes dwell with the most advantage.

THE BOOK OF PLANT DESCRIPTIONS: or, Record of Plant Analyses. By GEORGE G. GROFF. Lewisburg, Pa.: Science and Health Publishing Company. Pp. 100. Price, 35 cents.

THIS is a book of blanks, for the botanical descriptions of plants as elucidated by the student in his analyses. Each plant is given a page, containing skeleton forms, to be filled in, in separate lines for each part, with characteristic descriptions respectively, of the root, stem, leaf, inflorescence, and other distinctive features; it being supposed that the student will insert nothing but what he himself has observed. For his aid are also provided a synopsis of the terms most frequently used in the description of plants, a schedule of work to be performed in the botanical laboratory, and a list of subjects suitable for theses.

SIGNING THE DOCUMENT—THE LAOCOON OF LABOR—CHOPPING SAND—and other Essays. By WHEELBARROW. Chicago: "The Radical Review." Pp. 132.

THE author of these essays assumes the name of "Wheelbarrow," he asserts, because he once labored with pick, shovel, and wheelbarrow on a railroad. He also states that he was once "clerk" to a brick-layer —that is, that he carried bricks for him. The series of essays was begun under prompting of the thoughts suggested by the telegraphers' strike of 1883; and most of them have grown out of other movements of working-men to better their condition. The burden of them is to expose the folly of the present management of those movements, and this is done in the most vigorous manner, whether it relates to trades-union despotism and exclusiveness, to the silver craze, or to any of the various tricks by which demagogues and monopolists, of whatever rank, seek to impose upon men who work—and all without hostility to any association for their real benefit. "In the present condition of society," says the author, "not to organize would be the very imbecility of resignation on the part of working-men. They may follow unwise principles for a time, but out of that organization a correct education will come at last."

WONDERS AND CURIOSITIES OF THE RAILWAY; or, Stories of the Locomotive in Every Land. By WILLIAM SLOANE KENNEDY. Chicago: S. C. Griggs & Co. Pp. 254. Price, $1.25.

A PLEASANT book of history, gossip, and anecdote, about the origin and development of railways in Europe and America. The statements of fact are derived from authentic sources, and the anecdotical serves to give variety to the solid part. The volume is illustrated by cuts of various engines and cars, including the earliest made, that give graphic representations of the modest originals from which the present provisions for the accommodation of travelers have been worked out.

LESSONS IN CHEMISTRY. By WILLIAM H. GREENE, M. D. Philadelphia: J. B. Lippincott & Co. Pp. 357. Price, $1.25.

THE author of the "Lessons" is Professor of Chemistry in the Philadelphia High School. He has prepared them upon the theory that the object of a limited course in chemistry is not to make chemists of the pupils, but to teach them what the science is, what it has accomplished, and what it may accomplish; and that the study of the science can be made attractive only by arousing natural curiosity as to the cause of the

phenomena, while no greater mistake can be committed than to endeavor to make the facts dependent upon the theory. With brief explanations of principles, descriptions are given, in an attractive style, of the elements and their more considerable compounds, and of the more important chemical processes. "The Chemistry of Life" is explained in the last chapter; and notes on crystallography and hints for the preparation of experiments are given in an appendix.

THE LAWS OF HEALTH. By JOSEPH C. HUTCHISON, M. D. New York: Clark & Maynard. Pp. 223.

A MANUAL of physiology and hygiene, including a discussion of the effects of stimulants and narcotics, for educational institutions and general readers. It aims to present as clear and concise an exposition of the subject as its elementary character will permit, and to introduce enough of anatomy and physiology to enable the pupil to study intelligently the laws by which health may be preserved and disease prevented. In an appendix are given practical directions for dealing with poisons and meeting emergencies, and for general sanitation.

SYSTEMATIC MINERAL RECORD. By EDWARD M. SHEPARD, A. M. New York: A. S. Barnes & Co. Pp. 26.

THIS manual consists of directions for determining the properties of minerals, with explanations of the terms by which they are denoted, and a form of schedule for recording observations. Lists of chemicals, apparatus, minerals, and books are given.

REPORT OF THE UNITED STATES COMMISSIONER OF FISH AND FISHERIES FOR 1880. Pp. 1,106. Ditto for 1881. Pp. 1,217. Washington: Government Printing-Office. 1884.

THE report for 1880 covers the tenth year of the work of the commission. Besides the commissioner's report, this volume contains papers on the plan of the work of the commission; deep-sea research, with illustrations of apparatus; the sea-fisheries; economic research; natural history, including a long and copiously illustrated paper on the sword-fishes, propagation of food-fishes, and about 350 pages on oyster-culture, also copiously illustrated. The volume for 1881 contains papers on the construction and work of the steamer Fish-Hawk, with figures of the steamer and its fittings; the mackerel, shad, and other fisheries; various biological researches; and the propagation of food-fishes.

TEXT-BOOK OF MEDICAL JURISPRUDENCE AND TOXICOLOGY. By JOHN J. REESE, M. D. Philadelphia: P. Blakiston, Son & Co. Pp. 606. Price, $4.

THIS work has been prepared to meet the wants of students who desire something more convenient and manageable than the ponderous volumes in which the subject is more fully elaborated by the master-writers upon it. The author has endeavored to condense into a handy volume all of the essentials of the science, and to present the various topics in a simple and familiar style, giving larger prominence to those of the greatest practical importance. Special attention is given to the subject of toxicology, and fullness to the chapter on insanity.

REPORT OF THE COMMISSIONER OF EDUCATION FOR THE YEAR 1882–'83. Washington: Government Printing-Office. Pp. 1165.

THIS report contains a vast amount of information in regard to the public schools and colleges of the United States, with some glances at foreign educational systems. The number of children in the country of school age, which in twenty-six States and Territories ended only with the twenty-first year, was 16,243,822; the enrollment in public schools was 10,013,826. The total expenditure for public schools reported was $91,158,039. The commissioner recommends an appropriation for the museum connected with the office, to enable it to collect and distribute the best illustrations of improved educational appliances; an appropriation for organizing an educational system in Alaska, which matter has since been attended to by Congress; and he renews recommendations as to the appointment of a Superintendent of Public Instruction for each Territory, and national aid to education from the public-lands money. The report contains a view and plans of the new building of the Harvard Medical School.

REPORT OF THE COMMISSIONER OF AGRICULTURE FOR THE YEAR 1883. Washington: Government Printing-Office. Pp. 496.

THE commissioner continues the policy of establishing as intimate relations as possible between the department and the associations and institutions of the country which are devoted to the development and improvement of the art of agriculture, and of calling around it those whose knowledge and influence have given them especial authority; and he has perceived beneficial results from his course. Special subjects of investigation within the department have been the examination of microscopic fungi on plants, the chemical examination of cereals, experiments with sorghum, and the investigations in the entomological division on insects injurious to vegetation. The vegetation of the new and undeveloped parts of the country has been studied, especially the grasses, of which those that may promise to be useful for meadows and grazing purposes have been sought. An experiment station for the investigation of the contagious diseases of animals has been established near Washington, under the direction of Dr. D. E. Salmon. The full reports of these several departmental divisions, and of the investigations, are given in the volume.

GEOLOGICAL SURVEY OF NEW JERSEY. Annual Report of the State Geologist for 1883. By GEORGE H. COOK, New Brunswick. Pp. 188, with Plates.

GOOD progress was made, during the year covered by the report, in the topographic survey of the State, and the largest part of the work of the geodetic survey is done. Among the special topics of geological and economical interest discussed are the tertiary and cretaceous formations of the southern part of New Jersey, with accounts of the artesian wells at Ocean Grove and Asbury Park; the red sandstone and trap-rocks; the archæan rocks and iron-ore; the iron-mines; exploring for magnetic iron-ore, and locating mines; the progress of drainage and provisions for water supply at sea-side resorts and in large towns; and notes on native iron, copper, and zinc ores, graphite, plumbago, and black-lead, with statistics of mineral productions, manufactures from clay, bricks, and lime. A part of the matter is in continuation of previous reports; much of it covers new ground.

OUR BIRDS IN THEIR HAUNTS. By Rev. J. HIBBERT LANGILLE, M. A. Boston: S. E. Cassino & Co. Pp. 618. Price, $3.

IN the descriptions of the birds of Eastern North America, which make up this volume, the author has given especial attention to singing and nesting habits, and has dwelt upon whatever other characteristics were curious in each case. He has aimed to give either a full life-history, or at least a brief sketch, of every species commonly met with east of the Mississippi. The book is mainly a record of personal observation, supplemented by the notes of a correspondent in the Hudson Bay country; it contains many bright anecdotes of bird-life, and is written in a popular style, though giving the scientific name (following Dr. Coues) of each species, with the length of the bird and the dimensions of its egg.

The birds which may be seen in the same season in our Northern States are grouped together. The general reader will probably find most that is surprising in the records of their winter habits, and he will gather also from these accounts that Mr. Langille's love of nature is not torpid in cold weather. "The author addresses himself especially to men of his own profession—the gospel ministry; and would earnestly urge them to become, as far as possible, the interpreters of Nature as well as of the written Word." He has had in view, also, the popularizing of bird-study among farmers; the sportsman as well as the naturalist will recognize him as a fellow; and he has, in short, tried to make "a book on birds for everybody." Cuts of twenty-five species are given. Unfortunately, the errata do not include all the oversights in proof-reading.

THE WONDERS OF PLANT-LIFE UNDER THE MICROSCOPE. By SOPHIA BLEDSOE HERRICK. New York: G. P. Putnam's Sons. Pp. 248. Price, $1.50.

THIS elegant little volume is a beautifully illustrated and thoroughly popular presentation of some of the most interesting aspects of vegetable life. Mrs. Herrick is not only an enthusiast in her devotion to plant-studies and the microscopical

pursuit of botany, but she writes in a clear and attractive style, and makes her pages very instructive in relation to the later and most curious questions of vegetable economy. A considerable portion of her book was first published in a succession of articles in Scribner's "Monthly," but she has added new matter to the volume on fungi and lichens, orchids, mosses, and corn and its congeners. She allots considerable space to the insectivorous plants because of the fascinating interest of the subject, and because so little has hitherto been done to popularize the work of Mr. Darwin in this direction. Mrs. Herrick's volume well illustrates that the romance of fact is equally fascinating with the romance of fiction, and a good deal more real.

MAGNETO-ELECTRIC AND DYNAMO-ELECTRIC MACHINES. By Dr. H. SCHELLEN. Translated from the third German edition by Nathaniel S. Keith and Percy Neymann, Ph. D. Vol. I. New York: D. Van Nostrand. Pp. 518.

IN the third edition Dr. Schellen greatly enlarged his work, dividing it into two volumes, and gave it a more technical character than it had in the previous editions. The first volume treats only of apparatus for generating electric currents, and for measuring the currents and their effects. The descriptions of machines are preceded by a chapter on electrical principles, and one on electrical measurements. Successive chapters deal with magneto-electric machines, dynamo-electric machines, and machines for producing continuous currents. Some later alternating-current machines, for the production of several currents, are described, and the volume ends with a discussion of the conditions of efficiency in dynamo-electric machines. Large additions relating to American machines have been made by Mr. Keith. The volume contains three hundred and fifty-three illustrations.

CASSELL AND COMPANY'S ILLUSTRATED HOLIDAY CATALOGUE. New York: Cassell & Co., Limited. Pp. 32.

THE special feature of the publications of the house of Cassell & Co. is the prominence which is given in them to high art, combined with literary merit. The present catalogue comprises a list of fine-art and juvenile publications selected from the larger catalogues as most suitable for the holidays. It is adorned with illustrations of a very artistic character, many of them full-page, and is altogether a most attractive as well as, to the expectant buyer, a useful book.

A MIGRATION LEGEND OF THE CREEK INDIANS, with an Introduction by ALBERT S. GATSCHET. Vol. I. Philadelphia: D. G. Brinton. Pp. 251.

THIS volume is Number IV of Dr. Brinton's "Aboriginal Literature." Mr. Gatschet's task is to present some results of ethnographic study of tribes who have lived in the territory just north of the Gulf of Mexico. Volume I now published contains accounts of the linguistic groups of the Gulf States, the Maskoki family, the Creek Indians, and the Kasi'hta migration legend, with text and translation.

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## PUBLICATIONS RECEIVED.

Feeding Experiments with Gluten-Meal. Massachusetts Experiment Station, Amherst; C. A. Goessmann, Director. Pp. 12.

The Duration of Color-Impressions on the Retina. By Edward L. Nichols, Ph. D. Pp. 10.

Onondaga Salt Springs. Annual Report of the Superintendent. Syracuse, N. Y. Pp. 39, with Charts.

Los Terrapleneros (The Mound-Builders). By José Manuel Mestre. Havana: Anthropological Society of Cuba. Pp. 30.

The Fucoids of the Cincinnati Group. By Joseph F. James, Cincinnati. Pp. 9, with Plates.

On Herderite. By F. A. Genth, Philadelphia. Pp. 6.

Report on the Phosphates of Alabama. By William C. Stubbs, State Chemist, State Department of Agriculture, Auburn, Ala. Pp. 33.

New York State Bar Association. Reports, Vol. VII. New York: Martin B. Brown, Printer. Pp. 255.

Genital Reflexes the Result of Phimosis. By T. Griswold Comstock, M. D., St. Louis. Pp. 26.

German simplified. Parts I, II, and III. By Augustin Knoflach. New York: A. Knoflach, Tribune Building. Pp. 48.

Aus Toscana (Out of Tuscany). By E. Reyer. Vienna: Carl Gerold's Sohn. Pp. 200, with Plates.

A Letter to Scientists and Inventors. By Lysander Spooner. Boston: Cuppies, Upham & Co. Pp. 23.

Natural Law; or, The Science of Justice. Part I. By Lysander Spooner. Boston: A. Williams & Co. Pp. 21.

Sound-Signals. By Arnold B. Johnson. New York: D. Appleton & Co. Pp. 16.

On Oxygen as a Remedial Agent. By Samuel S. Walliam, M. D. New York: Trow's Printing Company. Pp. 32.

Jewish Hygiene and Diet. By Carl H. von Klein, Dayton, Ohio. Pp. 22.

Deformaciones Artificiales del Craneo (Artificial Deformations of the Skull). By José R. Montalvo. Havana: Soler, Alvarez y Compañía. Pp. 32.

How to live a Century, and grow old gracefully. By J. M. Peebles, M. D. New York: M. L. Holbrook & Co. Pp. 99. 50 cents.

Catalogue of the Flora of Minnesota. By Warren Upham. Minneapolis: Johnson, Smith & Harrison. Pp. 193.

The Latest Researches in the Mœris Basin. By Cope Whitehouse. Pp. 6.

Rudimentary Society among Boys. By John Johnson, Jr. Baltimore: N. Murray. Pp. 56. 50 cents.

On Supposed Glaciation in Pennsylvania, south of the Terminal Moraine. By H. Carvill Lewis, Haverford College. Pp. 8.

Mr. Bradlaugh and the House of Commons, from a Hindoo Point of View. London: W. Swan Sonnenschein & Co. Pp. 54. Sixpence.

Altars and High Places among the Emblematic Mounds. By S. D. Peet, of Clinton, Wis. Pp. 13, with Plate.

The Relation of Micro-Organisms to Surgical Lesions. By Henry O. Marcy, M. D., of Boston. Pp. 16.

Mexican Resources and Guide to Mexico. By Frederick A. Ober. Pp. 93, with Advertisements.

"The Quiver" (American edition). Vol. I. No. 1. Monthly. New York: Cassell & Co., Limited. Pp. 64. $1.50 a year.

Pathology and Therapeutics of Diseases of the Nerve-Centers. By J. McF. Gaston, M. D., Atlanta, Ga. Pp. 28.

Medical Education. By Henry Leffmann, M. D., D. D. S., Philadelphia. Pp. 39.

Committee on Metric System, Ninth Report. Boston Society of Civil Engineers. Pp. 4.

Asiatic Cholera in North America. Illinois State Board of Health, Springfield. Pp. 24.

Recommendation for Exclusion and Prevention of Asiatic Cholera. By John H. Rauch, Springfield, Ill. Pp. 11.

The Jury in Modern Corporate Life. By Edwin Young, Albany. Pp. 16.

College Mathematics: An Address. By Henry T. Eddy, Ph. D. Salem: Salem Press. Pp. 16.

Astronomical Papers prepared for the Use of American Ephemeris and "Nautical Almanac." Vol. III, Part II, pp. 144; Part III, pp. 80. Washington: Bureau of Navigation, Navy Department.

The American Lesson of the Free-Trade Struggle in England. By General M. M. Trumbull. Chicago: Schumm & Simpson. Pp. 290.

Fichte's Science of Knowledge. By Charles Carroll Everett, D. D. Chicago: S. C. Griggs & Co. Pp. 287. $1.25.

Vocal and Action Language. By E. N. Kirby. Boston: Lee & Shepard. Pp. 163. $1.25.

A Politician in Trouble about his Soul. By Auberon Herbert. London: Chapman & Hall. Pp. 296.

Elements of English Speech. By Isaac Bassett Choate. New York: D. Appleton & Co. Pp. 220. $1.

The Bassett Claim. By Henry K. Elliott. New York: G. P. Putnam's Sons. Pp. 267. $1.

The Way out. By Charles J. Bellamy. New York: G. P. Putnam's Sons. Pp. 191. $1.

Elementary Text-Book on Physics. By Professors W. A. Anthony and C. F. Brackett. New York: John Wiley & Sons. Pp. 246. $1.50.

Poems by Sidney Lanier. Edited by his Wife. New York: Charles Scribner's Sons. Pp. 252. $2.50.

Bermuda. By Julia C. R. Dorr. New York: Charles Scribner's Sons. Pp. 143. $1.25.

The Reality of Religion. By Henry J. Van Dyke, Jr., D. D. New York: Charles Scribner's Sons. Pp. 146. $1.

Tenants of an Old Farm. By Henry C. McCook, D. D. New York: Fords, Howard & Hulbert. Pp. 460. $2.50.

An Elementary Treatise on Analytical Mechanics. By Edward A. Bowser, LL. D. New York: D. Van Nostrand. Pp. 511.

Principles of Political Economy. By John Stuart Mill. Abridged, etc., by J. L. Laughlin, Ph. D. New York: D. Appleton & Co. Pp. 658.

Comparative Physiology and Psychology. By S. V. Clevenger, M. D. Chicago: Jansen, McClurg & Co. Pp. 258. $2.

The New Philosophy. By Albert W. Paine. Bangor, Me.: O. F. Knowles & Co. Pp. 163. $1.08.

"Science" Reports of the Meetings of the Scientific Associations in Montreal and Philadelphia. Cambridge, Mass.: "Science" Company. Pp. 90.

Report of an Archæological Tour in Mexico in 1881. By A. F. Bandelier. Boston: Cupples, Upham & Co. Pp. 325, with Plates and Photographs.

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# POPULAR MISCELLANY.

**The International Prime Meridian Conference.**—The International Conference, for fixing upon a prime meridian whence longitude should be reckoned, began its sessions in Washington, October 1st. Twenty-five nations were represented by forty delegates. Rear-Admiral C. R. P. Rogers, U. S. N., was chosen President of the Conference, and Lieutenant-General Strachey, of Great Britain, Mr. Janssen, of Meudon, France, and Dr. Cruls, of Rio Janeiro, were elected secretaries. A number of American scientific men and foreign visitors of scientific reputation, not regular delegates, were allowed to attend the meetings, with the understanding that they might participate in the discussions on special invitation. The first resolution adopted by the Conference declared the desirability of adopting a universal meridian. A resolution was then offered recommending the meridian of Greenwich as a standard meridian for longitudes, but it was withdrawn to allow the French delegates to introduce a resolution providing for a neutral meridian, which should cut no great continent. To this, it was objected that no suitable observatory was situated in any place which such a meridian would pass through; and that the selection of a meridian so situated would require a new set of observations and surveys to connect it with existing longitudes, and a readjustment of seventy-five per cent of all the world's charts, at an expense of about ten million dollars. The resolution for a neutral meridian was lost by a large majority. The resolution, "That the Conference proposes to the governments represented the adoption as a

standard meridian that passing through the center of the transit instrument at Greenwich," was then adopted, every state represented voting in favor of it except San Domingo, which dissented from it, and France and Brazil, which did not vote. The next resolution, recommending the counting of longitude in two directions from Greenwich, up to 180°, east longitude to be reckoned *plus*, and west longitude *minus*, was adopted by a small majority over the proposition to count continuously in a single direction to 360°. A fourth resolution proposed "the adoption of a universal day for the purposes for which it may be found convenient, and which shall not interfere with the use of local or other standard times where desirable." The fifth resolution recommends "That the universal day is to be a mean solar day, is to begin for all the world at the moment of mean midnight of the initial meridian coinciding with the beginning of the civil day and date of that meridian, and is to be counted from zero up to twenty-four hours"; the sixth, "That the Conference expresses the hope that as soon as may be practicable the astronomical and nautical days will be arranged everywhere to begin at mean midnight"; the seventh, "That this Conference expresses the hope that the technical studies to regulate and extend the application of the decimal system to the divisions of the circle and of time shall be resumed so as to permit the extension of this application to all cases where it presents real advantages."

**Characteristics of North American Flora.**—In a paper read in the British Association on the characteristic features of North American vegetation, Professor Asa Gray spoke of the resemblances and differences between the flora of North America and that of Europe, and their causes. The trees of the Atlantic border are similar to those of Europe. Many plants—among which are species of rhododendron, cypripedium, and coreopsis—may be found growing wild here, which are cultivated in the gardens of Europe. America is remarkable for its wealth of species of trees and shrubs. Besides the variety of leguminous trees and the wealth in species of *Compositæ* noticeable in America, there are many tropical plants which extend northward into the United States.

**The Cotton Production of Alabama.**—Some curious facts are brought out in Professor Eugene A. Smith's report on the "Cotton Production of Alabama." This State stands fourth in the United States in the total production of cotton, and also in the product per square mile (13·6 bales). The highest product per acre in the State is reached in Baldwin County in what is agriculturally styled the "long-leaved pine region," and the next highest in Cherokee County, in the "Coosa Valley region." In a larger sense, the highest rate of production is obtained in the central belt, having an area of less than seventy-five miles, which gives from seventeen to forty-three bales per square mile; the next highest, in the "Tennessee Valley region," which gives fifteen; and next, the Coosa Valley and the "oak, hickory, and long-leaved pine" regions, which give thirteen bales each to the square mile. The product of the State as a whole is equivalent to a little more than a bale for every two of its inhabitants. More than fifty-five per cent of the colored population of the State is found in the central cotton belt, where sixty per cent of the cotton is produced; and it is observed that so closely "does this class of the population follow the best lands, that the density of the colored population of any region might almost be taken as an index of the fertility of its soils," while the whites are much more evenly distributed over good and poor lands alike. This, however, is not strange, when we remember that the colored people were introduced as agricultural laborers, and put where they could be most advantageously employed. What should be the best cotton-lands begin to show signs of exhaustion through long and improvident cultivation. This is a logical result of the character of the laborers, who are unintelligent and not interested in keeping up the quality of the land, and of the inability or indisposition of owners to invest in improvements looking beyond the present year's crop. The general custom of depending upon advances of credit on the faith of the next year's crop has its influence in promoting deterioration of the soil. As cotton is the only crop which will always bring ready money, the planting of that staple is usually insisted on by the merchants making the advance, and it is also selected

by the farmer as the security to be offered. In this way it comes to be the paramount crop, and little chance is given for rotation with other crops.

**Economy of Light.**—In a paper before the American Association, on the "Economy of the Electric Light," Mr. A. Sterling stated that, for lighting a compact block, the incandescent light could be regarded as not more expensive than gas at $1.69 per thousand. Mr. Preece stated that the same quantity of gas gave more light when used to work an engine than could be got from it by burning it in the best gas-burners. Instances were given during the discussion where the amount of goods manufactured had been increased, or the quality of the goods improved, more than ten per cent, by the introduction of electric lighting. Mr. Preece explained the superiority of the electric light by showing that while in the arc-light a candle-power was obtained by the expenditure of one watt of energy, or in the incandescent light of two and a half watts, gas required the equivalent of sixty-two and candles of ninety-seven watts, for every candle-power produced. The most formidable obstacle to universal electric lighting was shown to be the great cost of the mains for conveying the electricity over long distances.

**Velocities of the Krakatoa Air-Wave.**—Professor Tacchini has found by examination of the Richard barograph that slight abrupt oscillations occurred in the barometric curves at Rome, on the 27th, 28th, and 29th of August, of last year, while the general daily record of the pressure was not essentially changed. Comparing the times at which these oscillations took place with the record of the times of the shocks at Krakatoa, he has deduced from them the conclusion that the wave of the shocks reached Rome from Krakatoa by the west, leaving the volcano at a velocity of 277 metres a second, while the wave moving in the opposite direction left it with a velocity of 296 metres. He further calculated that the complete atmospheric circuit round the globe was effected by the east, leaving Rome at a velocity of 295 metres, and of 318 metres for the wave going by the west.

**The Wind as a Land-Carver.**—A paper by General Prjevalski, on the structure of the plateaus of Central Asia, suggests enlarged views of the effects which atmospheric agencies have had in modifying the forms of mountains and valleys. Winds of excessive violence seem to have caused the fragments of stone to wear one upon another, and to have ground them up into pebbles, gravels, and sand; then to have carried the lighter parts of these materials to the valleys and deposited them there as a loess which has constantly grown thicker with succeeding years and centuries. M. Alluard has remarked upon an accumulation of wind-deposits that seems to have taken place on the Puy-de-Dôme. A temple of Mercury of considerable size formerly existed on the top of that mountain, but it has been covered up in the sand for nearly two thousand years; and, till some twenty or thirty years ago, none of the visitors to the place could have suspected that they were walking over such a structure.

**Illusory Memories.**—A curious question is presented by that experience of memory which nearly every person has probably had, in some form or degree, in which, when introduced to a scene or event really new, we have an impression, more or less distinct, of having met it before. Professor Henry L. Osborn, writing upon the phenomenon in "Science," suggests that it may arise from the dual structure of the brain, as the result of imperfectly correlated action in two images or impressions not absolutely simultaneous. The latter impression, being a repetition of the former one, gives rise to a feeling that it has passed through the mind at some indefinite previous time. Or, the false or illusory memory may have a real basis in some actual past representation which is identical or closely similar to the present one, or in some past images of the waking imagination, or dream-life. Plato conceived that these impressions gave support to the theory of a state of pre-existence in which identical experiences may have occurred. Mr. Sully suggests that the impression may be an inherited recollection of something that occurred to an ancestor. Lewes and Ribot ascribe the illusions to a false placing of a present mental image or

idea. Abercrombie tells a story of a lady who in extreme infancy was brought to her dying mother in a strange room to be taken leave of. Long afterward, having grown up with no recollection of her mother, she went into the room again, for the first time afterward, without the fact with which it was associated having been mentioned, when the whole scene of the leave-taking came back to her with force. Had not the connection of events been clearly traced, this instance would have been classed with the curious impressions we are considering.

**Velocity of Pulse-Waves.**—Continental physiologists have determined that the velocity of the pulse-wave is about twenty feet a second, and that the rapidity of its progress is essentially dependent upon the rigidity of the tubes through which it travels. Dr. A. T. Keyt, of Cincinnati, has supplemented their observations by experiments to determine the effect of other conditions in modifying the speed. He first set himself to determine the precise influence of tubes of different degrees of stiffness or elasticity on the velocity of the liquid waves sent along their interior, and selected for this purpose, first a glass tube, then India-rubber tubes of varying strength and firmness of pull, then tubes made of chicken-gut, and finally the aorta of a calf. The experiments demonstrated that the velocity of liquid waves in elastic tubes is proportional directly to the stiffness and inversely to the elasticity of the tube traversed; and they indicate the important modifying influence which the state of the arterial walls as to stiffness or elasticity must exert upon the rate of pulse-propagation in living arteries. In the series of tubes which he used, the velocity fell gradually from 216 feet per second in a tube of glass to 12·75 feet in a calf's aorta. In further experiments it was found that the rate of pulse-propagation is not affected directly by the manner of the heart's action, whether it beats quickly, launching a sharp wave, or slowly, sending a sloping wave; that, other things being equal, the pulse-wave travels more slowly along large, and faster along small, arteries; that mere distance from the heart neither accelerates nor retards the velocity of the beginnings of pulse-waves, while the modifying influence of different pressures is small at most; that liquid waves travel along elastic tubes at the same speed, whether the liquid be at rest or freely flowing; and that the consistence of the fluid makes no difference in the velocity of the wave.

**The Earthquake of September 19th.**—A light earthquake-shock was felt in West Virginia, Ohio, Indiana, and Michigan, on the 19th of September, between half-past two and three o'clock in the afternoon. The estimates of its duration vary from five to twenty seconds. No damage was done beyond the displacement of light articles, the throwing down of a chandelier in the insane asylum, and the jarring down of a freshly built arch, at Columbus, Ohio. In some places, schools, a Methodist conference, a woman's missionary society, etc., were temporarily dispersed by the panic. An observer at Indianapolis noticed that the tremor ran from east to west, and another counted seventeen distinct vibrations. At Lawrenceburg, Indiana, and at Toledo, Ohio, the indications were that the wave passed from southwest to northeast; at South Bend, Indiana, the motion appeared to be from north to south. At Wheeling, West Virginia, it was from northeast to southwest. A Signal-Service officer at Covington, Kentucky, who was reading the thermometer at the time, observed no agitation of the mercury. Boat-captains at Detroit say there was a noticeable rise in the river at the time of the shock. The earthquake was also felt at London, Ontario.

**Hibernation of Snakes.**—Mr. Arthur Stradling is investigating the hibernation of serpents, with particular attention to the greater sensitiveness to cold which they show in the spring than in the fall. He had under observation during last winter twenty-six snakes of different species. Some of them fed last in the latter days of September; and then they retired to the hibernating place provided for them at intervals one by one, the first one when the temperature had fallen to 41°, the last one on the 2d of December. Occasionally, some of them came out, under the temptation of warmth or light, when "it was most ex-

traordinary, according to one's preconceived ideas, to behold these creatures, some of them roaming about on the tree and gravel when the snow was lying on the ground outside, and the glass, which they were almost touching, was flaked with ice; even the pseudo-tropical specimens remained out until the temperature was much lower than that which seems to render our English species dormant. Though prepared for a well-marked difference in the temperatures of their retreat and reappearance, I had no idea that it would present so wide a range. Another curious anomaly was exhibited in the fact that daylight rather than warmth seemed to operate in drawing them forth; they all sought the box at dusk, although my reading-lamp raised the temperature of the room from 2° to 4° above that of the chilly morning, when they would issue from the aperture." Mr. Stradling believes that the difference in sensitiveness to cold manifested by his snakes at the seasons of retiring and waking is explainable on the same physiological principles as those which mark the condition of all animals in the fall and spring. In the fall, vital activity is at its highest; the animal has accumulated a coating of fat under its skin, and a store of combustible matter within to last it through the winter, and is able to endure much more cold than in the spring, when its vitality is weakened and its fat coat and surplus aliment are consumed.

**Krakatau's Present Condition.** — MM. Breon and Korthals, having just visited Krakatau and the region devastated by last year's eruption, have made a report upon the present condition of affairs there. The formerly flourishing city of Telok Betong no longer exists. The splendid vegetation of the Island of Seboukou has been destroyed by the joint action of the sea and the storm of hot cinders. The Island of Lebesia is completely covered with cinders and pumice. From the south, the Island of Krakatau presents the ordinary profile of volcanic cones. An appearance, when seen from a distance, as of clouds of vapor playing over the scarp, seems to indicate the existence of fumeroles; but on a nearer approach these clouds prove to be only masses of dust rising from land-slides which are continuously taking place. The travelers tried several times to approach the mountain from this side to obtain specimens, but were always repelled by a terrible bombardment of projectiles of every size. They succeeding in landing from the west, where there were no slides. Thence they were able to see distinctly, in the scarp, beds of rocks lying one upon another, separated only by small beds of siliceous tufa, as in all volcanic countries. The rocks apparently belong to the family of basalts, consisting of labradorites containing very little peridote. The recent eruption afforded products of a very different character, very acid pumices, seventy-two per cent of silica with plagioclase, bronzite, and magnetite. The former substance, which has, by emulsion with the gases, formed pumices, is a bottle-green glass, pieces of which may be found in the recent pumice-beds. Evidences were observed of a former acid eruption of the volcano.

**Major Powell on American Languages.** —Major Powell, in his paper at the British Association on the "Classification of American Languages," expressed the opinion that no other method of classifying the Indian tribes than by languages would be found satisfactory. The physical differences are certainly not sufficient. The arts are no criterion, as they are readily adopted by one race from another. Institutions are more permanent; but still in some cases they are adopted, and they do not sufficiently distinguish the races. Mythologies are more distinctive; and, indeed, it will generally be found that tribes speaking languages of one stock have similar mythological beliefs. There are in North America about eighty linguistic stocks, and as many mythologies. Major Powell proposed some important reforms, with a view to simplification and uniformity in the nomenclature of American languages.

**Wampum.**—In a paper read before the British Association on the "Nature and Origin of Wampum," Mr. H. Hale traced the use of that money across the continent to California; thence to the Micronesian groups in the North Pacific, where it is universal; and thence to China, where the money is said to have been anciently made of tortoise-

shell disks, or slips strung on cords. The common copper "cash" is made in imitation of this tortoise-shell currency, and is strung in a similar manner, and is used in ceremonial observances, like the American wampum. This form of money may originally have been introduced from China to the tribes of the western part of the continent, by means of shipwrecked junks. A discussion having risen as to whether wampum was a real currency or measure of value, Mr. Cushing stated that it had a definite value among the Zuñis. Dr. Tylor said that the shell-money is in use among the Melanesians, just as other currency is in the trade of civilized nations, and when lent is expected to be returned, with interest; the borrower of nine strings is expected to pay ten strings at the end of a month.

**Homologies between North America and Europe.**—Herr Valentine Ullrich has drawn a comparison of the morphologies of North America and Europe, for the purpose of showing that these two continents, though widely separated, exhibit, in their horizontal extension and the conditions dependent upon it, such points of agreement as can not be found in a similar degree between any other two parts of the world. He suggests that they may therefore be regarded as like two organic beings of the same species; as alike when regarded in the aggregate, and exhibiting the differences constituting individuality only in the details. North America should be considered as a sixth quarter of the globe, independent of the adjoining continent, the boundary-line from which is easier to draw than that separating Asia from Europe. The line is that marked by the Rio Chicapa or Chimalapa, flowing to the Gulf of Tehuantepec, and the Rio Quetzocoalcos, flowing to the Gulf of Campeachy, the sources of which rivers, only about four miles apart, are connected by the broad depression of the pass Portillo de Tarifa. It is recognized that the degree of civilization and intelligence which Europe has attained has been promoted by its situation between the seas, by its easy accessibility, by the extent of its river systems, by its numerous harbors, and by its freedom from impassable mountain-ranges. Similar conditions in North America tend to bring about a similar inevitable result; and this continent, not only on account of the energy of its inhabitants, but also on account of the advantages of its topographical features and climate, is destined to be the rival of Europe. Its surprisingly quick development in greatness and wealth is the result of no accident, but is the consequence of favoring natural conditions, without which even its most enterprising population would not have been able to accomplish so much. By reason of those conditions, the American States are promised an important future, and Europe is assured against decrepitude and decadence. Europe has strongly in its favor the broken shape of its land masses and the convenience of its seas, which serve as highways to the distant countries they reach in every direction. North America possesses similar advantages, but in a less marked degree. It is vastly more extensive than Europe; but Europe has relatively the larger coast-line, and is much better provided with harbors.

**Against Over-pressure in Schools.**—Commissions have been at work in several of the German states investigating the conditions of over-pressure in the schools, and official action has been taken on their reports to relieve the evil, for which physical exercise has been found not to be a sufficient counteractive. In Hesse, a limit has been fixed to the amount of home-study that may be imposed, and tests of progress that necessitate much reviewing have been forbidden. The Saxon Government has issued decrees against excessive attention to technicalities and the imposition of useless exercises in the classical departments, and particularly against the "*extemporalia*," or dictation exercises in the foreign languages, which, it is said, are calculated to produce in the student "a feeling of anxiety and vexation instead of an agreeable consciousness of knowledge." In Baden, the teaching-hours and the hours for home-study have been reduced, and the memorization of Latin words is disapproved of. The study-hours have also been reduced in Alsace-Lorraine, and six hours a week of physical exercise imposed. A petition, signed by teachers, physicians, and others, has been addressed to the Prussian Chamber of Dep-

uties, setting forth the mischievous effects of excessive strain upon the nervous system of scholars, and asking that an end be put to an abuse which "threatens, little by little, to reduce the cultivated classes of society to a state of moral weakness that shall render them incapable of great and manly resolution."

**Effects of Tobacco on Youth.**—Dr. G. Decaisne has made special observations of the effects of tobacco in thirty-eight youths, from nine to fifteen years old, who were addicted to smoking. With twenty-two of the boys there was a distinct disturbance of the circulation, with palpitation of the heart, deficiencies of digestion, sluggishness of the intellect, and a craving for alcoholic stimulants; in thirteen instances the pulse was intermittent. Analysis of the blood showed, in eight cases, a notable falling off in the normal number of red corpuscles. Twelve boys suffered frequently from bleeding of the nose. Ten complained of agitated sleep and constant nightmare. Four boys had ulcerated mouths, and one of them contracted consumption, the effect, Dr. Decaisne believed, of the great deterioration of the blood, produced by the prolonged and excessive use of tobacco. The younger children showed the more marked symptoms, and the better-fed children were those that suffered least. Eleven of the boys had smoked for six months; eight, for one year; and sixteen, for more than two years. Out of eleven boys who were induced to cease smoking, six were completely restored to normal health after six months, while the others continued to suffer slightly for a year.

**Danger from Overhead Wires.**—Professor Sylvanus P. Thompson mentions as one of the most solid objections to overhead wires, that they are a permanent and absolute source of danger, because every wire of whatever kind deteriorates more or less slowly under atmospheric influences, especially in the smoky, sulphur-laden air of cities. Those best qualified from long experience to speak on the subject agree that the life of every wire is limited, and no one can tell how or when it will snap. The fact has been established by Professor Hughes that every vibration imparted to a wire brings it a stage nearer to a state of internal crystallization, when, its fibrous structure having become completely degenerated, it snaps short. He has measured the number of vibrations which determine the length of life of wires of different kinds, and finds it to be varying according to the material, but limited in every case. "Given at first a wire of ideal perfection, when it has swayed to and fro its allotted number of hundreds of thousands of times in the breezes, it must snap. But no such wire is attainable; all are more or less faulty, and can not be relied on, even with the most diligent inspection, when once set up in the smoky air." Numerous accidents, according to Mr. Preece, have arisen from the falling of wires, and a case is on record where an omnibus-driver was decapitated from such a cause.

**Atmospheric Action on Sandstone.**—M. E. Wadsworth, of Cambridge, records certain observations on St. Peter's and Potsdam sandstones, made several years ago near Mazomanie, Wisconsin. The St. Peter's sandstone is composed almost wholly of a pure quartz sand, and in the outliers of it, found on the hill-tops south of the town, the parts covered by the soil were more or less friable, and the grains distinct; while the exposed portions of the same blocks and slabs were greatly indurated, the grains being almost obliterated, and the rock possessed the conchoidal fracture and other characteristics of a quartzite. In the autumn of 1872 a block of clear white Potsdam sandstone was found, the protected side of which was friable, while the other sides, especially the one most exposed to the prevailing storms, was nearly a quartzite. This block was only about two feet square, and, as a test of the correctness of the above conclusion, the indurated surface was broken off, and a comparatively friable surface exposed. This locality was visited the following spring, when the fresh surface was found much indurated, and approached toward a quartzite.

**Phosphoric Glass and its Applications.**—At a recent meeting of the French Academy of Sciences, a number of articles were presented for inspection that were made of a glass composed simply of phosphate of lime. The new application is the invention

of M. Sidot, who has been carrying on successful experiments with it since 1877, and has made most excellent tubes, bottles, and retorts, of "phosphoric glass." Vessels of this substance are particularly useful in manipulating the fluorides, for phosphate of lime is not acted upon by fluorine. M. Henri de Parville foresees an interesting use to be made of phosphoric glass in connection with cremation. The ordinary part of that process having been completed, our ashes, instead of being deposited in a vase, will be reduced to phosphate of lime; this substance then converted into phosphoric glass; and the glass molded into a vase, a medallion, or a memorial statuette of the person from whom it has been derived.

**Advantages of Woolen Underclothing.**—The advantages of woolen underclothing, besides its warmth, and the closeness of its application, depend upon its better adaptation in respect of temperature to the requirements of climates and to changes of season than any other material for dress. It also has a special faculty for absorbing and distributing moisture that makes it particularly salutary next to a perspiring skin. A linen garment will absorb the products of transudation till it is wet and becomes sticky upon a moist and clammy skin, while flannel will rest upon a skin which it has nearly dried, and be only damp itself. Hence, the body wearing flannel is in the best condition to resist the after-chills that follow great perspiration. The irritation caused by flannel, which is brought up as an objection against it, is an accompaniment only of new flannels and coarse ones, and is generally a merely transient condition.

**Patagonian Geology, and a Former Southern Continent.**—Señor F. P. Moreno has communicated to the Argentine Scientific Society the results of geological explorations which he has made in Patagonia, beginning in 1876. In the ascent of the Santa Cruz, at five degrees above where Darwin had given up a further exploration of that river, he came upon a country roughly cut up by cañons, and presenting most of the peculiar features of our "Bad Lands." About halfway between the mouth of this river and the Andes, he discovered a region "forming the base of a high terrace, surmounted by high peaks that gave it the aspect of a half-ruined Gothic cathedral, exceedingly rich in tertiary mammalia. In the upper part of this formation, which was about two hundred and fifty metres high and one hundred and fifty metres broad, were discovered, beneath the superficial layers of glacial *détritus*, several alternating lacustrine and marine beds indicating successive immersions and emersions. In them the three divisions of the Tertiary period were represented by very distinct mammalian fossils corresponding with ancient forms of marsupials, pachyderms, edentates, rodents, and carnivores. Perhaps one of the most curious features of these fossils was the number of transitional forms among them; an animal combining features of the marsupials, the land carnivores, and the pinnipeds, in such a way "that, if the remains did not exist and we should describe an animal possessing all their characteristics, we should be thought to be imagining some fabulous monster"; animals of an order intermediate between the ungulates and the rodents; and a molar, "which can be attributed only to a gigantic *cabiai*, or a dwarf elephant." This fauna is more ancient than the Argentine mammalian fauna, and is probably quite as comprehensive. The discoveries have thrown a new light on the geological history of South America; for Patagonia was formerly regarded as of marine origin, but they prove much of it to have been terrestrial and lacustrine. They also lend some weight to the opinion expressed by Señor Moreno that, at the beginning of the Tertiary period, a vast continent, of which Patagonia was a part, extended east and west. The rich fauna and the luxuriant vegetation, evidences of which are also found, could not have come down from regions nearer the equator, as has been supposed, that is, from more favorable to less favorable conditions, but must have originated in this region, and pushed up toward the tropic under the influence of the growing cold that came upon the country. The southern part of the continent still shows signs of oscillation. An elevation of one hundred and fifty metres would consolidate the land with Tierra del Fuego and the Falkland Islands into a continent as wide as Africa at the Orange River

An elevation of less than two thousand metres would unite this land with South Georgia, South Sandwich Land, and the Antarctic Continent. The chain of the Andes has not the same continuity in these regions as in the north of the continent. The labyrinth of islands and channels constituting the Straits of Magellan and Le Maire is only a continuation of the isolated moraines and cañons, now dry, which so singularly break up the ground of Patagonia. The presence of marsupials and the seventy-seven common species of plants likewise point to the possibility of a former nearer relation to Australia and New Zealand than now exists.

**Wine-Statistics of the World.** — The greatest wine-producing country of the earth is France, which also furnishes the greatest variety and the most-sought-for wines. The total production of the country has fluctuated greatly in late years, on account of the ravages of the phylloxera. It was nearly 2,246,000,000 gallons, wine measure, in 1875, and less than 689,000,000 gallons in 1879. The average is estimated at 1,456,000,000 gallons. The vine is cultivated in all but nine of the eighty-six departments, but most extensively in the southern departments, that of Hérault leading the list. Italy ranks the second among the wine-lands, with an average production about half that of France, or of 715,000,000 gallons, the total value of which is estimated at a milliard of lire. The export trade is growing fast and has become very large. Spain follows as the third greatest wine-producing state, with 583,000,000 gallons. The southern wines are in greatest demand, and the export trade is assuming enormous dimensions. Next in order is Austria-Hungary, with 371,000,000 gallons, a large part, and the choicest, of which is produced in Hungary. Portugal is fifth among European wine-lands, with 132,000,000 gallons, among which are the famous port wines, forming the basis of a large export trade. Germany, with only a small part of its land in cultivation for wine, and an annual return of 95,400,000 gallons, does not produce as much as it consumes, but imports from France and Austria-Hungary. Russia produces 53,000,000 gallons, chiefly in the southern provinces, or those bordering on the Black and Caspian Seas. Of the smaller states, Greece produces about 39,750,000 gallons; Switzerland, 36,320,000; European Turkey, 26,000,500; Roumania, 31,800,000; and Servia, 13,250,000. Belgium makes the smallest showing of all the European states that produce any wine. The total production of the fourteen states enumerated is estimated at 3,577,500 gallons a year. Wine is also a very important staple of Asiatic agriculture, and forms a notable item in the crops of all of Asiatic Turkey, Palestine, Arabia, Persia, Afghanistan, Bokhara, and parts of India, while in Cochin-China, China, and Japan, it is of relatively small account. In Africa it is a considerable item in Algeria and the Cape Colony, and is made in only mentionable quantities in Egypt, Abyssinia, Morocco, the Orange Free State, and the Transvaal. The wine-culture of the Canary Islands and the Azores has recently suffered greatly from diseases of the vines. The United States produced 23,453,000 gallons of wine in 1880, and it was worth $16,000,000. More than a quarter in value of the product came from California. Wine is produced in a primitive way in Mexico, Brazil, the Argentine Republic, and Chili. The wine industry has been developed to a considerable importance in Australia, and promises to grow.

**Science and Industrial Development.**— One of the demands of the times, according to "Nature," is for the co-operation of scientific investigation in the study of new principles with artisan skill, in immediately applying the new discoveries to practical uses. As among the fields in which such a combination might prove itself valuable, it is suggested: "There is great need of some system of light railways which can be laid down on ordinary roads, and so cheaply that the traffic available on such roads may be sufficient to pay a fair return on the capital. . . . The storage of power, such as that of the tidal-wave, with cheap and ready means for giving it out when and where it is needed, offers a wide field for invention, and may lead to the most fruitful results. The transmission of power to long distances, whether by electricity, compressed air, or otherwise, is a somewhat similar problem, which at present occupies the attention of many en-

gineers and men of science. Lastly, the more homely subject of house-building offers at this moment special inducements to constructive genius." "Nature" fears, however, that the prominent part in speeding progress in this line of invention is destined to fall to other countries than England. The latest and most important movements in the direction of cheapened transportation and the storage and transmission of power have been made in France, Germany, and America, while, in respect to scientific architecture, "England stands far nearer the bottom than the top in the scale of civilized nations." This is because "in America, in France, above all in Germany, the union between science and art is far more close and cordial than with us. Every practical constructor or manufacturer is anxious to know all he can of science; every scientific professor desires to mix practice with his theory. Thus, on the one hand, we find ordinary engineers drawing on all the resources of mathematics for the solution of such problems as the proper section of rails or the resistance of trains; on the other hand, we see Clausius, perhaps the greatest of German physicists, devoting two long papers to investigate the working theory of the dynamo-machine."

**Antiquity of Fossil Human Skeletons.**—Mr. T. V. Holmes, of the Essex Field Club, England, discussing the recent "find" of a human skeleton in the alluvial clays of Tilbury, showed that the skeleton was comparatively recent, though undoubtedly prehistoric, and added that geological position furnishes the only absolute test of relative age. The test of association with extinct mammalia is largely dependent on negative evidence. A hint on this point was given by the results of the drainage of Haarlem Lake thirty years ago. Excellent sections were made in all directions across its bed, and carefully examined by skilled geologists. Hundreds of men were known to have perished in its waters three centuries before, and it had always been the center of a considerable population. Yet no human bones were found, though works of art were discovered. Thus hundreds, or even thousands of mammalia, incapable of producing works of art, might be interred in particular strata, and yet leave no signs whatever of their former existence two or three centuries afterward. And, on the other hand, were extinct mammalia present in the Tilbury Dock beds, no additional antiquity would thereby be conferred on the beds themselves, but the period at which the animals became extinct would be shown to be later than had been supposed. Similarly, as regards the rude implements known as palæolithic, their presence could confer no antiquity on recent beds.

**Gathering Edible Birds'-Nests.**—The material from which the famous Chinese bird's-nest soup is made can be obtained in quantities at only one place in the world, and this spot has been visited recently by Mr. Pryer, a naturalist of Yokohama, Japan. It is at Gomanton, some thirty miles up the Sapugaya River, in British North Borneo, in two caves, called by the natives the Black and the White Caves, which are situated in a limestone cliff 900 feet in height. The Black Cave is 100 feet wide, by 250 feet high at the eaves, with a roof rising to 360 feet high in the middle. The interior is well lighted by holes in the roof, and is filled with clusters of the nests of bats and swifts. The White Cave is 400 feet higher up. Mr. Pryer discovered the material from which the nests are made in the shape of a soft, fungoid growth that incrusts the limestone in all damp situations, where it attains the thickness of about an inch, and is dark brown on the outside and white in the inside. The birds make the black nests from the outside layer, and the white nests, which are best esteemed, from the inside. The "moss" is taken by the bird in its mouth and drawn out in a filament backward and forward, like a caterpillar weaving its cocoon. A wonderful sight is witnessed at night, when the bats fly out of the caves in a score of flocks of many thousands each, with a rushing noise, and the birds come in in a similar style, and in the morning when the birds go out and the bats come in. Near the center of the largest cave, the explorer was shown a small beam of light from a funnel at the top of the rock, exactly 696 feet above his head. The nests are gathered from these enormous elevations by means of pendent, flexible rattan ladders and stages.

On these two men take their station; one carries a light, four-pronged spear about fifteen feet long, just before the prongs of which a lighted candle is fixed. Holding on with one hand, he manages the spear with the other hand, transfixes the nest, and detaches it from the rock. He then pushes the spear toward the second man, who takes the nest off the prongs and puts it in his "game-bag." The annual crop is estimated to be worth from $25,000 to $30,000, local value, and much more in China. The caves have been worked for seven generations, without any apparent diminution in the product, although three crops are gathered in the year. The floors of the caves are covered with a deposit of guano of unknown but great thickness.

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## NOTES.

CORRECTION. — The paper on "School Culture of the Observing Faculties," in the December "Monthly," was written by Mr. J. C. Glashan of Ottawa, Canada, and not Glashaw, as printed.

M. G. CHAUVET, in a monograph on the prehistoric polishing tools of Charente, France, notices the fact that flints very like some of the stone-age hatchets were, till recently, used in the factories of Angoulême for polishing playing-cards. The polishers are now made of copper.

A NUMBER of the members and officers of the Academy of Natural Sciences of Philadelphia have associated themselves into a Bureau of Scientific Information, the object of which is to impart, through correspondence, precise and definite information bearing upon the different branches. The bureau consists so far of twenty members, each of whom volunteers his services in his particular field of investigation. Professor Angelo Heilprin is secretary of the association.

CERTAIN mushroom universities in the West and South seem anxious to put a high-sounding degree of some sort "within the reach of all." The allurements of these institutions include, in the department of letters, the degrees M. E. L. (Master or Mistress of English Literature); M. L. A. (Mistress of Liberal Arts); L. E. L. (Laureate of English Literature); L. A. (Laureate in Arts); B. E. (Bachelor of English); M. P. L. (Mistress of Polite Literature); and M. L. (Master of Letters); in science, A. C. (Analytical Chemist), and B. S. (Bachelor of Surgery); and in other departments are offered M. P. (Master of Philosophy); B. P. (Bachelor of Painting); M. A. (Master of Accounts); and L. I. (Licentiate of Instruction). One institution gives the degrees B. P. (Bachelor in Pedagogics); P. P. (Principal of Pedagogics); T. E. (Topographical Engineer); S. (Surveyor); and B. D. A. (Bachelor of Domestic Art). A person acquainted only with the effete colleges of the East would be at a loss on what scale to estimate the attainments of those who had been graduated with these degrees.

SIR H. E. ROSCOE, speaking in the British Association of the diamantiferous deposits of South Africa, and the ash of the diamond, showed that silica and iron oxide form constant constituents of the diamond. He also stated that, when these yellow diamonds are heated out of contact with the air, they lose their color, and remain colorless so long as they are not exposed to the light; they then regain their color.

MR. F. W. PUTNAM described before the American Association the exploration of the "Turner" group of mounds near Madisonville, Ohio, which had been conducted in the most careful and thorough manner, with examination of the earth shovelful by shovelful. The discoveries, both of objects obtained, and of facts regarding the structure of the mounds, were exceedingly valuable. Among the objects, some of which had never been found before in mounds, were shell-beads, disks, and rings by the thousand; cones cut from alligator-teeth; ornaments from buffalo-horn, mica, and copper; objects of native silver, gold, and meteoric iron; 50,000 pearls, mostly pierced and injured by heat; small stone dishes carved in animal forms; and artistically shaped figurines of terra-cotta, suggesting an Egyptian character.

NORDENSKJÖLD is understood to be preparing a new three years' expedition under Russian auspices, the object of which is the north pole. He will start first for the newly discovered Bennett Islands, Henrietta and Jeannette, in the New Siberian Archipelago, where depots of provisions will be made; thence to Franz-Josef Land, where other provisions will be left, and whence a start will be made in three divisions, for the pole.

THE meeting of German naturalists, which opened at Magdeburg on the 18th of September, under the presidency of Dr. Gachde, was attended by more than a thousand men of science. Among the addresses delivered was one on the relation of micro-organisms to the infectious diseases of man, by Professor Rosenbach, of Göttingen. Dr. Gerhard Rohlfs spoke on the importance of German colonization in Africa.

In the Biological Section of the American Association, Dr. G. M. Sternberg described his experimental research relating to the etiology of tuberculosis. He had repeated the inoculation experiments of Koch, with similar results. The experiments of Formad to induce tuberculosis in rabbits, by introducing into the abdomen finely powdered inorganic material, had been repeated, with entirely negative results. Dr. Sternberg held that Koch's bacillus was an essential factor in the etiology of tuberculosis.

Sunlight or starlight in passing through our atmosphere loses by absorption an amount which is commonly rated at twenty per cent of the whole. By experiments made both near the sea-level and at altitudes of nearly 15,000 feet, Professor S. P. Langley has been brought to the conclusion that the previous determinations are largely in error. He believes it probable that the mean absorption of light (and of heat also) by the atmosphere is at least double that which is customarily estimated, and that fine dust-particles play a more important part in this absorption than has been heretofore supposed.

Professor Landolt recently exhibited before the Academy of Berlin a cylinder of solidified carbonic acid which had been kept for more than an hour in that condition. He had prepared it by passing liquid carbonic acid from a compressor into a conical sack of canvas, in which it assumed the form of melting snow, and then ramming the whole into a cylindrical vessel.

Signor Michela, of Italy, has devised a kind of telegraphic short-hand which he calls steno-telegraphy. It consists of a machine by which signs corresponding to various sounds can be telegraphed, and by means of which, it is claimed, 10,000 words can be sent in an hour. It has been used for some time in telegraphing the debates of the Italian Senate.

M. E. P. N. Fournier, a French botanist whose death was recently announced, edited in connection with M. Egger the work of Theophrastus on plants, and was preparing a flora of Mexico for the French Government and a flora of Brazil for the Emperor Dom Pedro.

Senhor Ladislao Netto, of Rio Janeiro, in a lecture on evolution at Buenos Ayres, gave some remarkable illustrations, from his own observations, of the power of plants to adapt themselves to diverse conditions. The same plants which became enormous vines in the dense Brazilian forests may be found growing as ordinary shrubs in the open. He and M. Lacerda have found the *Strychnos triplinervia* in isolated situations as a bush a little over six feet high, with no signs of a climbing tendency except a few atrophied tendrils; while in a wood only a few steps away another individual of the same species had a slender stem, with internodes, sixty feet in length; and the plant frequently grows to be seventy-five feet long. Other plants are mentioned by Senhor Netto, particularly the *Thorinia scandens*, which after having become quite respectable vines, began to increase irregularly in thickness immediately on having the sunlight let in upon them.

Observations made by Dr. L. Glaser, of Mannheim, in the river-valleys of Germany during the wet seasons of 1882–'83 and 1861–'62 have led him to the conclusion that heavy winter rains and floods are very destructive to insect-life, and have a marked effect in diminishing the "bug-crop" of the following season.

Recent observations of the British Meteorological Office on the temperature of the Gulf Stream between the latitudes of the north of Ireland and Bordeaux, and extending half-way across the Atlantic, go to show that the temperature of the water was abnormally high (1° to 3° above the mean) during June, July, and August.

## OBITUARY NOTES.

Among the deaths of last summer was that of Count Constantin Branicki, an earnest promoter of natural science, who had made valuable contributions to the Museum of Warsaw, Poland.

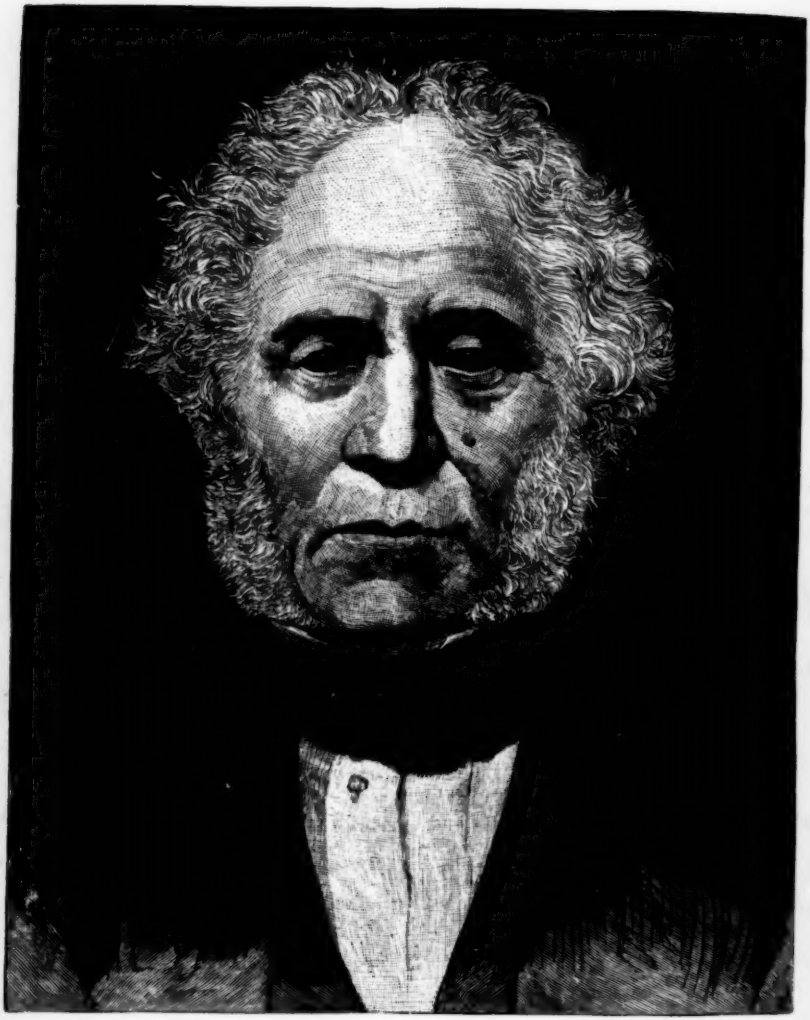
Professor Bros Emil Hildebrand, one of the most distinguished of European antiquaries, died at Stockholm, on the 30th of August last. He was Royal Antiquary of Sweden, and under his care the Swedish archæological collections became among the richest and most curious in Europe.

Julius Cohnheim, a German pathologist, is dead, in his forty-fifth year. He was a pupil of Virchow's, and filled professorships at Kiel, Breslau, and Leipsic.

Among the active students of botany who died last year are E. P. M. Fournier, at Paris, and Ludovico Caldesi, at Faenza, Italy.

G. B. Delponte, formerly Professor of Botany in the University of Turin, died some months ago at Mombarrizzo, Piedmont. He was well known for his researches on the *Desmidiæ*.

Chemistry has lost by death, during the past year, Dr. Carstanjen, of Leipsic, who was fifty-nine years old, and Dr. Hans Hübner, director of the chemical laboratory at Göttingen, who was in his forty-seventh year.



SIR DAVID BREWSTER.